Electronic Services - Los Angele
M11477X

pressure strain torque

measurement

SR-4
gages
sensors
transducers
instrumentation
accessories

BLH BLH Electronics, Inc., Where you turn first!
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Bulletin 001-1

BLH Electronics

This catalog presents the products of America's most comprehensive physical measurement and control corporation ... BLH Electronics, Inc. From sensors to complete instrumentation/control systems, BLH is where you turn first for precision and know-how in dealing with strain, weight, force, pressure, torque, temperature, linear and angular positioning.

BLH was the first to manufacture precision resistance strain gages in the United States and, since that time, has been the preeminent developer of strain gage technology. (BLH now produces over one million strain gages per year.)

The strain gage...with its inherent accuracy, stability and reliability... is the basic sensing device used in the company's physical measurement components. The strain gage has allowed new levels of measurement capability to be achieved in such components as:

- Load cells... for weight and force measurements from 20 pounds to 1.5 million pounds per cell with accuracies to 0.05%.
- Pressure transducers... for measurements from below 15 psi to 200,000 psi with accuracies to 0.25%.
- Torque transducers... for measurements from 10 inch-pounds to 75,000 inch-pounds with accuracies to 0.25%.

For use with these sensors, BLH manufactures advanced laboratory and process control instrumentation having exceptional accuracy, automation and human factors design. Instruments are available for:

- Selecting, monitoring, combining and amplifying the outputs of all physical measurement sensors.
- Scaling of the sensor outputs for direct readout and/or processing in engineering units (feet, pounds, psi, kgs, etc., as required).
- Processing measured data for control of material flow, batching, temperature and other factors in automated plants.
- Displaying, recording and printing out measured data and/or status of operations.

As required by customers, BLH can provide process control system equipment plus installation and calibration assistance. Or, BLH can provide complete process control systems on a turnkey basis.

Spare parts inventories for all instruments and sensors are maintained throughout the nation. Field service personnel are available whenever, wherever needed. Training for customer personnel can be arranged as required.

pressure strain torque load measurement

Where to turn first for:

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Standard SR-4 wire and foil strain gages

The complete family of SR-4 wire and foil strain gages contains over 1000 different models capable of precision measurement over a broad range of conditions:

- In cryogenic temperatures to −452°F.
- In elevated temperatures to +1800°F.
- With tension and compression strains better than 10%.
- With accurate resolution of strains over lengths as small as 0.007 in.
- Under static and dynamic test conditions.

Many different grid configurations are available... a few are shown on the facing page. Any of numerous Rosette designs may be selected to resolve magnitudes and directions of components in multiaxial stress fields. (Both planar and stacked Rosettes are included in the standard gage line.)

Temperature compensated gages are available for applications in which the greatest accuracy must be maintained over a range of temperatures. The compensated gages are closely matched to the thermal expansion coefficients of specific materials... quartz, molybdenum, titanium, mild steel, stainless steel, aluminum, magnesium and plastics.

The standard gage family also contains a very wide choice of models with:

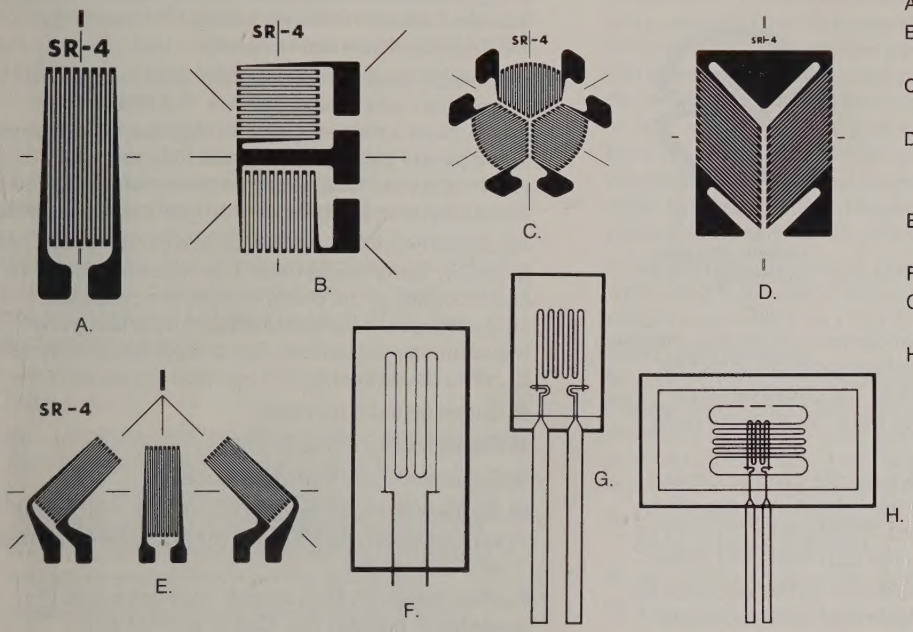
- Bonded, strippable, frame and free-filament carrier systems.
- Lead and pad designs for connection to instrumentation wiring via soldering or welding.
- Resistances of 120, 350, 500, 1000 and 5000 ohms to match standard types of bridge readout/excitation instrumentation.

Polyimide and paper-backed gages longer than ⅛ inch can be used to measure strains up to 4% or 5%. Shorter polyimide and paper gages will withstand strains to 2% or 3%. The phenolic-glass gages will also handle strains of 2%. Any gage applied with ceramic adhesive will be limited to strains of approximately 0.5% by the inelastic properties of the adhesive. For larger strains at high temperatures the Rokide flame spray adhesive process may be used to achieve strain measurements up to 1%.

The range of standard SR-4 wire and foil gages available from BLH is shown in the table below. Full details on all gages are available in bulletin 100.

Characteristics of SR-4 Standard Wire and Foil Strain Gages

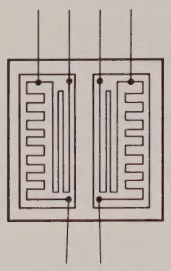
Gage Type	Type Prefix	Carrier	Recommended Temperature Range (°F)
General Purpose, Constantan Foil Grid	FAP FAQ	thin paper	−100 to +150
	FAE FSQ	polyimide	−100 to +400
	FAB	phenolic-glass	−100 to +450
General Purpose, Constantan Wire Grid	A	paper wrap	−100 to +100
	A, AF	flat paper	−100 to +150
	AB	Bakelite wrap	−100 to +250
	ABD	Bakelite wrap	−100 to +250
	AB, ABF	Bakelite flat	−100 to +300
General Purpose, Dynamic Iso-Elastic Wire Grid	C, CD	paper	−100 to +150
	CB, CBD	Bakelite	−100 to +250
Widest Range Dynamic, Dynalastic Wire Grid	DLB-PT	phenolic-glass	−320 to +600
Transferable From Carrier, Nichrome V Foil Grid	FNO, FNH	free-filament transferable from carrier	−452 to +600
Ceramic and Flame Spray Bonding, HT Free-Filament Wire Grid	HT-200	free-filament transferable from teflon-glass (all units)	−452 to +600
	HT-400		−100 to +450
	HT-800		−452 to +600
	HT-1200		−320 to +1200
High Temperature, Stabiloy Foil Grid	FSM	polyimide-glass	−452 to +600
Cryogenics, Nichrome V Foil Grid	FNB	phenolic-glass	−452 to +600



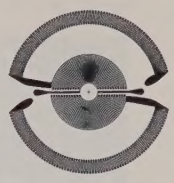
A. Uniaxial, foil
B. 2-Element rosette, 90° planar, foil
C. 3-Element rosette, 60° planar, foil
D. 2-Element rosette, 45° shear planar, foil
E. 3-Element rosette, 45° planar, foil
F. Uniaxial, wire
G. Uniaxial, wire, ribbon leads
H. Uniaxial, wire, free-filament, removable carrier

Extended Temperature Range (°F)	Compensated Temperature Range (°F)	Test Application (primary/ secondary)	Gage Lengths Available (in)	Nominal Gage Factor
−320 to +180	+50 to +150	static/dynamic	1/32 to 1/2	2.1
−320 to +600	+50 to +400	static/dynamic	1/64 to 1/2	2.1
−320 to +600	+50 to +400	static/dynamic	1/32 to 1/2	2.1
−320 to +150	none	static/dynamic	1/16 to 6	2.0
−320 to +180	+50 to +150	static/dynamic	1/4 to 1	2.0
−320 to +350	none	static/dynamic	1/8 to 5/16	2.0
−320 to +350 (st)	none	static/dynamic	1/8 to 5/16	2.0
−320 to +400 (dy)				
−320 to +400	+50 to +250	static/dynamic	1/16 to 3/4	2.0
−320 to +180	none	dynamic	1/4 to 7/8	3.3
−320 to +350	none	dynamic	1/4 to 5/16	3.3
−452 to +600	none	dynamic	1/8 to 1/2	4.0
−452 to +700 (st)	none	static/dynamic	1/4 to 1/2	2.2
−452 to +1800 (dy)				
−452 to +700 (st)	none	dynamic/static	1/8 to 1/2	2.2
−452 to +1800 (dy)				
−320 to +450 (st)	+50 to +400	static/dynamic	1/4 to 1/2	2.0
−320 to +600 (dy)				
−452 to +600 (st)	+75 to +600	static/dynamic	1/4 to 1/2	2.2
−452 to +1800 (dy)				
−452 to +1200 (st)	none	dynamic/static	1/8 to 1/2	4.0
−452 to +1500 (dy)				
−452 to +750	+75 to +600	static/dynamic	1/32 to 1/4	2.1
−452 to +600	none	static/dynamic	1/16 to 1/4	2.2

Special-purpose wire and foil strain gages



Weldable gage, full bridge



Diaphragm gage, full bridge

Strain gages with special carriers, envelopes, metallic conductors and patterns have been designed by BLH for many applications. The gages listed on this page are those which have found particularly wide use.

The post yield gages have ductile conductors and can thus handle larger strains than their standard wire and foil counterparts. Strains over 10% can be accurately measured by the BLH post yield gages.

Limestone cement adheres well to the Valore-Brass envelope of the concrete embedment gages and this assures very good coupling of strain from concrete to gage. These gages are sealed units designed for long term survival in concrete structures; the gages may remain operational in place for extended periods.

Polycarbonate encapsulation assures long term stability and environmental durability for the asphalt and ice embedment gage. This model has been used very successfully to measure the strains in airport runways subjected to the heavy loads of jumbo jets. And the gage is also well suited to use in ice and frozen soil. The gage has a low modulus of elasticity and can measure strains up to 6%.

Weldable gages are available as single elements and as full bridges. These gages are mounted on stainless steel carriers 0.005 inch thick for low energy welding directly to test materials.

Diaphragm gages are most often used in pressure transducers and similar devices. The diaphragm gages may contain single or multiple sensing elements; these gages can measure the tangential tensile strain at the diaphragm center as well as the compressive radial strain at the diaphragm perimeter.

As shown on this page, BLH is able to design strain gages for many varied uses. The inherent precision and flexibility of the photo etching process allows custom gages to be manufactured in virtually any two-dimensional pattern. For custom requirements BLH has developed:

- Gages up to 25 feet long.
- Gages having ultrathin foils.
- Gages with very high resistances.
- Gages with multiple grids resistance-matched to various materials for direct measurement of stress as well as strain.

Further details on BLH special-purpose gages are available in bulletin 100. Call or write at any time for information on gages custom designed to meet your specific requirements.

Characteristics of Special-Purpose Strain Gages

Type	Type Prefix	Carrier	Recommended Temperature Range (°F)	Extended Temperature Range (°F)	Compensated Temperature Range (°F)	Nominal Gage Factor
Post Yield Wire Gages...High elongation for strains to over 10%	PA	thin paper	+50 to +150	−50 to +180	none	2.0
Concrete Embedment Gages	AS-9	brass valore envelope	−50 to +100	−100 to +150	+50 to +150	2.1
Asphalt and Ice Embedment Gage	EMB 300-35	poly-carbonate	−100 to +275	−275 to +300	none	2.1
Weldable Gages	FABW	0.005″ stainless steel (all)	−100 to +500	−320 to +600	+50 to +250	2.0
	FNW		−452 to +700	−452 to +1200	none	2.2
	FNWFB		−452 to +1000	−452 to +1200	−452 to +1000	3.5
Diaphragm Gages	FAES, FAES-4	polyimide	−100 to +400	−320 to +500	+50 to +150	2.1

Semiconductor strain gages and solid state sensors

Semiconductor gages and sensors are extremely sensitive... some models have gage factors as high as 150. Devices in these families are manufactured from single-crystal silicon in which the piezoresistive effect produces a large resistance change per unit of applied strain.

Semiconductor gages

The BLH semiconductor strain gages are matched, documented, temperature-controlled and compensated devices for use when high accuracy is required. Very small strain levels can be measured by these devices. And, the output voltage capabilities of the semiconductor gages are very high compared with wire and foil gage outputs. Thus, the semiconductor gages:

- Are ideal sensors for use in high output transducers.
- May eliminate need for amplification and complex instrumentation in many applications.
- Can often improve measurement accuracy when contact resistance (and resistance variation) of switches, leads and/or slip rings would degrade readings obtained from wire or foil gages.

The semiconductor gages are extremely stable. Single-crystal silicon is perfectly elastic; thus the gages exhibit no hysteresis, drift or creep. Also, the gages have a very high fatigue life and are well suited to measurement of dynamic strains and forces.

However, semiconductor gages are more temperature-dependent than wire and foil gages, and the semiconductor resistance-vs-strain curve becomes non-linear with increasing strain levels. Close compensation and /or correction for these effects can be achieved in many cases. BLH supplies temperature and strain level correction data with all semiconductor gages shipped. (BLH also proof tests 100% of all semiconductor gage filaments to 3000 in.x10^{-6}/in. tension before shipment.)

In the selection chart below, gages listed as general-purpose will provide the best combination of linearity, zero shift and strain sensitivity. The listed temperature-compensated gages are matched to the thermal expansion coefficients of various materials for improved accuracy over the +50°F to + 50°F range. High resistance gages offer the highest output level capabilities with minimum internal power dissipation. Short gages are selected from the other families to offer a range of characteristics and gage lengths as small as 0.03 inch.

All gages having phenolic-glass carriers are usable from −452°F to +500°F. All free-filament gages are usable from −452°F to +700°F.

Solid state sensors

Models in the sensor line are essentially the same as the semiconductor strain gages but without the detailed testing, matching and documentation performed on the gages. The sensors are the most economical choices for less critical applications:

- In calibratable transducers operating in relatively constant environments.
- As sound and vibration pickups.
- As overload warning and/or failsafe detectors.
- As position indicators.

For further information on semiconductor gages and sensors obtain bulletin 100; bulletin TD-4354; and the BLH Semiconductor Strain Gage Handbook.

Characteristics of semiconductor strain gages

Type	Carrier	Compensated Temperature Range (°F)	Nominal Gage Factor Range	Gage Lengths Available (in)	Nominal Resistances Available (ohms)
General Purpose	phenolic-glass or free-filament	none	+110 to +118	0.06 to 0.20	120, 350
Zero Shift Temperature-Compensated Gages	phenolic-glass	+50 to +150	−103 to −110	0.06 to 0.16	120, 350
High Resistance Gages	phenolic-glass or free-filament	none	+136 to +150	0.09 to 0.35	1000 to 5000
Short Gages	phenolic-glass or free-filament	none	+110 to +145	0.03 to 0.12	120, 350, 1000

Strain gage accessories

The BLH line of strain gage accessories contains everything needed to insure proper gage installation for measurements in any environment which can be withstood by the gage itself. The accessory line contains:

- Surface preparation materials.
- Adhesives.
- Protective coatings.
- Lead wire systems.
- Bonding aids.

The accessories are described on this and following pages. For a detailed listing of all accessories, obtain bulletin 104.

Surface preparation materials
These items are used for cleaning surfaces to which strain gages will be attached. The materials available from BLH include...chemical solvents...metal surface conditioners and neutralizers...mechanical cleaning agents...a portable, air-powered sand blast unit. Kits containing a selection of all surface preparation materials are available at low cost.

Strainline adhesives
The full performance of a strain gage is only realized if a quality bond couples the gage to the stressed material. Adhesives in the BLH accessory line provide such bonds over a wide range of environmental conditions as shown in the table below.

Protective coatings
These materials are used to prevent chemical and mechanical damage after a strain gage has been installed. The general properties of protective coating systems in the BLH accessory line are summarized on the facing page.

Strain gage adhesives

Type	Gage Compatibility	Minimum Cure	Safe Temp Range (°F)	Max Temp Range (°F)
Post Yield BLH SR-4 nitrocellulose	thin paper	10 hrs @ room temp; or 2 hrs @ 120°F	−100 to +180	−320 to +200
DUCO* nitrocellulose	std paper	48 hrs @ room temp; or 12 hrs @ 120°F	−100 to +150	−320 to +200
E-910** cyanoacrylate	all	none	−100 to +150	−320 to +200
BLH EPY-150 room temp filled epoxy	all	16 hrs @ room temp; or 1 hr @ 150°F	−320 to +150	−452 to +300
BLH EPY-350 med temp filled epoxy no mix	all except paper	2 hrs @ 350°F	−452 to +400	−452 to +500
BLH EPY-500 med temp filled epoxy	polyimide & phenolic	6 hrs @ 250°F; or 2 hrs @ 350°F	−452 to +400	−452 to +600
QA-1 Epoxy	all except paper	2 hrs @ 500°F	−320 to +425	−320 to +450
BLH EPY-600 high temp filled epoxy	polyimide & phenolic	1 hr @ 225°F	−452 to +600	−452 to +650
BLH-PLD-700 Polyimide	polyimide-glass (FSM series)	2½ hrs @ 500°F	−452 to +750	−452 to +800
Bakelite*** filled phenolic	Bakelite & phenolic	6 hrs @ 300°F	−320 to +300	−452 to +500
BLH CER-1000 ceramic	transferable/ free-filament	1 to 6 hrs @ 600°F	−452 to +1000	−452 to +1250
BLH CER-1200 ceramic	transferable/ free-filament	1 to 6 hrs @ 600°F 1 hr @ 1000°F	−452 to +1200	−452 to +1400
Rokide**** flame spray process aluminum oxide	transferable/ free-filament/ frame	none	−452 to +1500	−452 to +1600

* ® Dupont
** ® Eastman-Kodak
*** ® Union Carbide
**** ® Norton

Crack Detection Coating

Structures subjected to dynamic loading conditions often fail during service causing loss of property or even, at times, life. An early warning signal in such cases of impending fatigue failure is extremely important. This coating is typically used on metals and alloy during the investigation of fatigue characteristics and endurance limits under a variety of loading conditions.

The Crack Detection Coating basically consists of two layers; an epoxy base layer matrix containing microcapsules which are filled with an electrically conductive emulsion, and a top layer of silver conductive paint. The Crack Detection Coating is so designed as to crack whenever the underlying material cracks. The crack propagates very quickly into the epoxy matrix causing the microcapsules to rupture. The change in electrical resistance between the metal base and conductive paint is easily detected with an ohmmeter. Electrical observation can thus be made at a point remote from the member being monitored. This technique is particularly valuable if the coated area is not readily accessible or when an electrical alarm system is used.

Some application include:

- Crane Booms
- Key structural members on a bridge
- Aircraft structural members
- Large turbine or generator casings
- Weld joints

and, on any metallic structure in which fatigue fractures may occur.

Protective coatings

Type	Cure	Temperature Range (°F)	Protection Offered
BLH BARRIER A teflon-fiberglas tape with silicone sealer	air dry 1 hour	–325 to +150	moisture; some oils, chemicals; general atmosphere
BLH BARRIER B liquid vinyl coating & precoat	air dry 4 hours	–325 to +150	moisture; many chemicals & oils; general atmosphere
BLH BARRIER C air-cure RTV silicone rubber	useable after 2 hours; full cure in 72 hours	–100 to +450	moisture; oils; excellent mechanical protection
BLH BARRIER D semi-rigid epoxy	1 hour @ 150°F; 30 min @ 200°F	–100 to +225	moisture; oils; engine fuel; most chemicals & solvents; excellent mechanical protection
BLH BARRIER E press-on neoprene patch with integral rubber polymer	none; useable immediately	–20 to +200	moisture; general atmosphere; excellent mechanical protection
BLH BARRIER F urethane foam-in-place system	air dry 30 minutes	–350 to +350	moisture; most solvents; gasoline & oil; excellent mechanical & thermal protection
BLH BARRIER G flexible nitrile rubber...brush on	air dry 20 minutes	–452 to +300	moisture; gasoline & oil; cryogenic liquids
BLH BARRIER H silicone resin cover for Rokide flame spray or ceramic adhesives	1 hour @ 200°F; ½ hour @ 350°F; ½ hour @ 450°F; 1 hour @ 600°F;	–100 to +650	moisture; mechanical protection
BLH BARRIER J silicone coating	air dry 20 minutes	–75 to +250	moisture
BLH BARRIER WD Di-jell micro-crystalline wax	none	–100 to +150	moisture; general atmosphere
BLH BARRIER WC ceres micro-crystalline wax	none	–150 to +150	moisture; general atmosphere

Lead wire systems

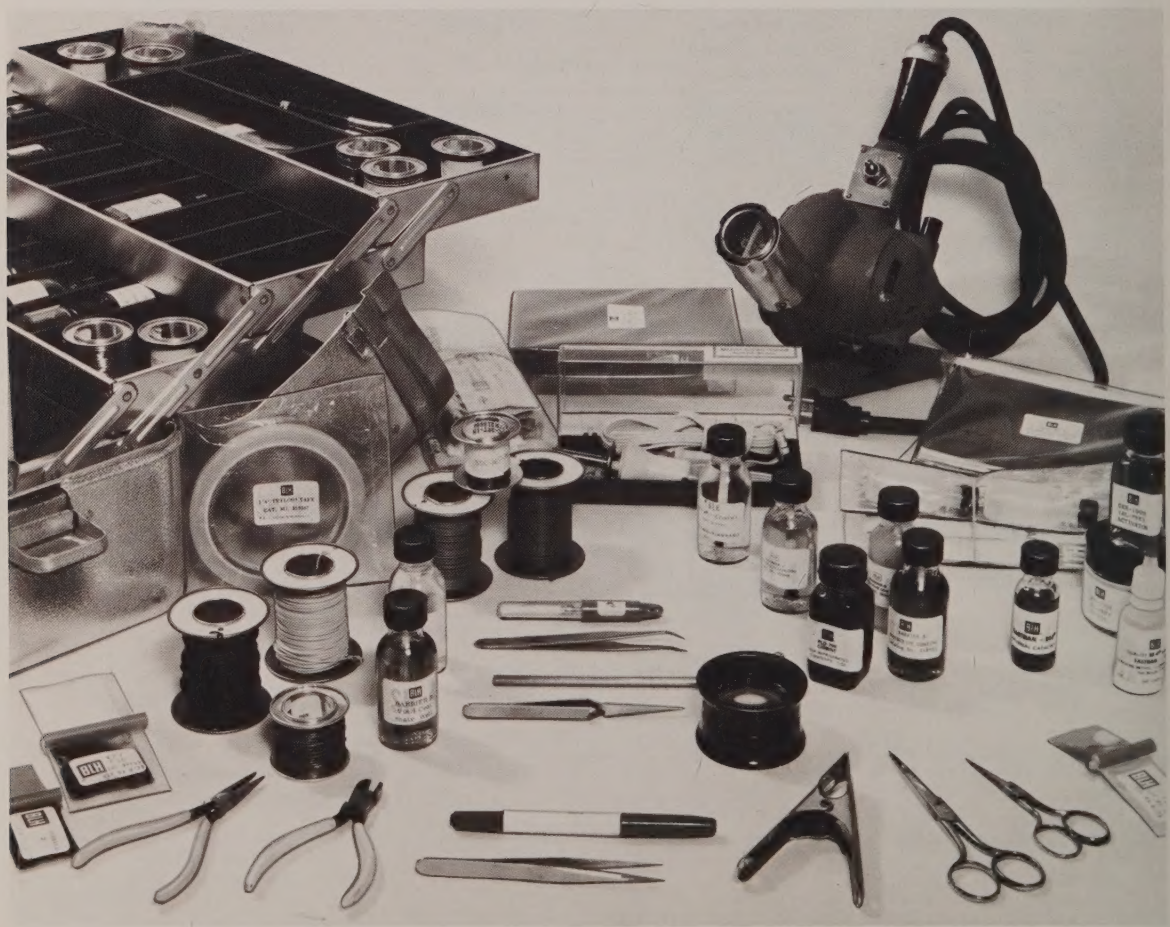
Connections from a strain gage to instrumentation wiring are best made via a lead wire system which matches the stability and environmental survival capabilities of the gage itself. The BLH line of lead wire system accessories contains terminals and connection wire components for operation from −452°F to +1300°F and higher. The available lead wire system supplies include:

- Terminals on various carrier materials for attachment to test surfaces via conventional strain gage adhesives.
- Terminals on stand-off mounts for attachment to test surfaces via welding.
- Terminals and mountings of ceramic for high temperature installations.
- Solid, stranded and ribbon wiring supplies of... copper, nickel-clad copper, stainless steel-clad copper, constantan, nichrome V and others. (Insulations of PVC, teflon, fiberglass and other materials are used according to environmental criteria.)

Bonding aids

BLH also carries all of the tools and special-purpose items which bring ease and exactness to strain gage installation procedures. The available bonding aids include:

- Gage installation hand tools and tool kits.
- Pressure pads and clamping devices.
- Soldering and welding supplies.
- Heat guns for curing/drying adhesives and protective coatings.
- Special tools for accurate trimming of gages after installation and for positioning of multiple gages accurately on test surfaces.



Temperature sensors

BLH micro-miniature thermocouples are the smallest, fastest, most accurate temperature sensors presently available. They produce a thermocouple junction emf proportional to temperature and are used with conventional thermocouple readout instrumentation techniques.

For less demanding applications, BLH manufactures lower cost nickel and platinum resistance thermometers. The extremely high purity metallic conductors in these devices exhibit a very repeatable resistance change with temperature. Conventional resistance measurement instrumentation techniques can be used with these sensors.

Micro-miniature thermocouple grids

- Extremely small (0.002" dia) fused-wire junction.
- Leads to junction are 0.002" thermocouple wire in grid winding having 1000:1 length/diameter ratio... provides absolute minimum measurement error from lead heat conduction paths.
- Total grid area (leads and junction) only ¼" x ¼" square with very low mass... provides short thermal time constant for fast response.
- Free-filament and self-adhering types available ...attach to test materials just like strain gages... free-filament types can be embedded in plastics and other materials.
- Models cover −320°F to +1500°F range.
- Full data available in bulletin 207

Micro-miniature thermocouple probes

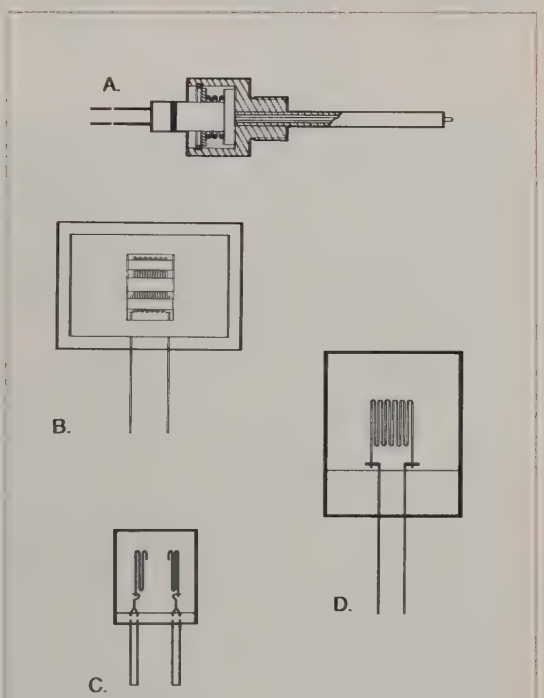
- 0.001" dia fused wire junction.
- 0.014" total probe diameter... extremely fast response... thermal time constant measured in milliseconds.
- Round shape, length and very small diameter minimize radiation and conduction errors... also minimize disturbance of gas/liquid flows (permit accurate temperature gradient measurements).
- Probe materials available for use in live tissue, corrosive media, hot oxidizing and reducing environments.
- Probe bodies available for manual testing or for permanent installations... ceramic lead insulation only 0.003" diameter... rugged, easy-to-handle output lead wires.
- Models cover −458°F to +5000°F range.
- Full data available in bulletin 205.

Nickel resistance thermometers

- Ultrathin, low-mass design presents minimum thermal resistance between sensor and test materials... low thermal time constant for fast response.
- Available with teflon carriers or phenolic-glass carriers... install just like strain gages.
- Both carrier types available with grid exposed on one side to permit direct thermal contact between sensor grid and test material.
- Models cover −350°F to +600°F range.
- Full data available in bulletin 206.

Platinum resistance thermometers

- Ultrathin, low-mass design provides minimum thermal resistance between sensor and test materials... low thermal time constant for fast response.
- Available as free-filament grid for bonding to test materials with strain gage cements or Rokide flame spray process.
- Also available encapsulated in high purity aluminum oxide refractory material on 0.006" thick stainless steel carrier for attachment to test materials via welding.
- Models cover −320°F to +1500°F range.
- Full data available in bulletin 209.



A. Typical thermocouple probe
B. Typical thermocouple grid
C. Typical nickel resistance thermometer
D. Typical platinum resistance thermometer

Pressure Transducers

All BLH pressure transducers employ bonded strain gage sensing elements. They offer high accuracy, excellent stability, long life and infinite resolution... a combination of characteristics unobtainable in any other type of pressure measurement device. (Some BLH pressure transducers are actually used as standards for calibrating other types of pressure sensors.)

Models are available with full-scale capacities from 50 psi to 100,000 psi for applications in:

- Process control systems
- Hydraulic and pneumatic force and control systems
- Pumping, pipeline and other gas/liquid delivery systems
- Aircraft and missile systems
- Laboratory measurement equipment

All models can be used with gases, liquids and slurries...any medium which acts as a fluid. Most models can be used with corrosive, chemically active media...any media compatible with 17-4PH stainless steel.

The BLH strain gage transducer designs employ no moving parts. Hysteresis is very small. Accuracy is maintained over a wide temperature range by matching component thermal expansion characteristics and by other design techniques...high temperature models can be used in continuous duty up to +600°F.

Free-flowing and viscous fluids can be handled with equal accuracy. Measurement cavities are very small (typically less than one cubic inch). Full rated pressure produces negligible change in cavity volume. Small volume, negligible change and low mass design provide very high frequency capabilities ...and fast response to pressure changes, even with light gases. The electronics are hermetically sealed within the transducer.

Some models contain strain gages bonded to a stiff diaphragm which stresses with pressure loading. These models are designed for easy disassembly and cleanout; they are exceptionally immune to vibration and static acceleration.

Other models have the strain gages bonded to the outer wall of a machined, one-piece tube with integral pressure connection threads. These models have no internal gaskets or fittings...the pressure cavity is completely seamless.

All BLH pressure transducers are designed for installation directly at the pressure source. Pressure

Pressure Transducer Selection Chart

Series	DHF	DV	GP
	General purpose **Small size** **High overload ratings** **Diaphragm sensor** **350-ohm bridge**	**High output...5 volts from built-in amplifier** **High overload ratings** **Diaphragm sensor** **Less than 10 ohms output impedance...can drive long cable runs**	**General purpose** **One-piece tube sensor** **350-ohm bridge**
Specifications			
Full-Scale Ranges Available (psi)	20 to 30,000; absolute or gage	20 to 30,000; absolute or gage	100 to 20,000; absolute or gage
Rated Output (RO)*	3.0 mV/V	5.0 Vdc	3.0 mV/V
Calibration Accuracy (% of RO)	0.25	0.5	0.15
Nonlinearity (% of RO)	0.15 (100-5k psi) 0.25 (all others)	0.15 (100-5k psi) 0.25 (all others)	0.35 (<500 psi) 0.25 (all others)
Repeatability (% of RO)	0.03 (<5k psi) 0.15 (all others)	0.05	0.05
Hysteresis (% of RO)	0.10 (<200 psi) 0.05 (200-5k psi) 0.15 (all others)	0.10 (<50 psi) 0.05 (all others)	0.15
Safe Operating Temp Range (°F)	−65 to +250	0-160	−50 to +250
Compensated Temp Range (°F)	0 to +150	+30 to +150	0 to +150
Temp Effect on Zero Bal (% of RO/100°F)	0.25	1.0	0.25
Temp Effect on RO (% of RO/100°F)	0.35	0.5	0.35
Recommended Excitation	10 V (dc or ac)	28 Vdc ±4 pwr input	12 V (dc or ac)

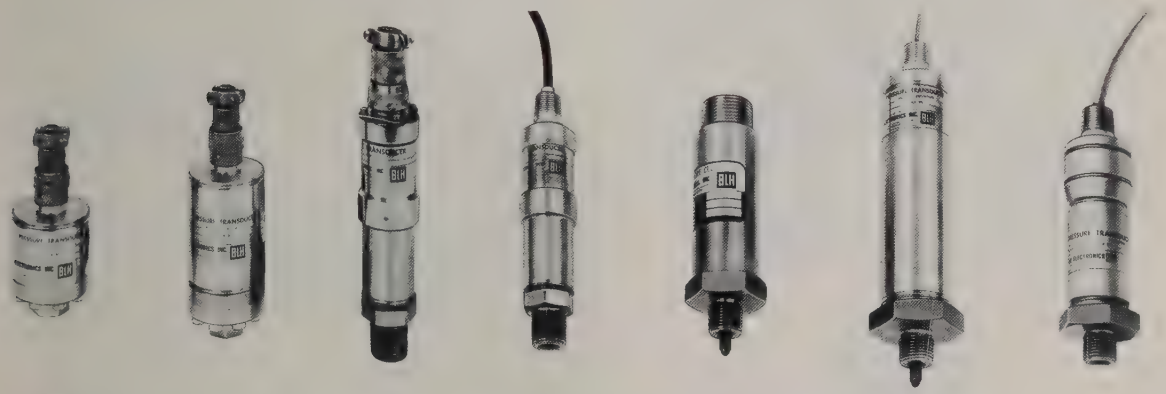
***Set at +77°F **Over entire compensated temperature range ***True psig is available on the 50-100 and 200 psi capacities.**

information is routed to indicators and other instruments via low cost, easily installed electrical cables. Elaborate pressure plumbing runs are not required. The pressure medium remains within its container... need not flow in and out of long piping connections.

Besides the standard models listed on these pages, BLH manufactures many special models for various applications...

- Type PP transducers are designed specifically for use with pipelines at pressures from 100 to 2,000 psi (gage).
- Type HF transducers have extremely high frequency characteristics, nearly double the frequency response of standard transducers.

Write or call for information on any pressure measurement problem. Obtain BLH bulletin 402 for detailed data on all pressure transducers.



DHF DV GP GP-H STD STD-H STD-H2

	GP-H	STD	STD-H	STD-H2
	High temperature **Version of GP series for continuous duty to +425°F** **One-piece tube sensor** **350-ohm bridge**	**Extremely rugged design** **Very high pressure models** **One-piece tube sensor** **120-ohm bridge**	**High temperature** **Version of STD series for continuous duty to +425°F** **One-piece tube sensor** **120-ohm bridge**	**Very high temperature** **Version of STD series for continuous duty to +600°F** **One-piece tube sensor** **120-ohm bridge**
	100 to 20,000; absolute or gage	5,000 to 100,000; gage	5,000 to 50,000; gage	30,000 to 50,000; gage
	3.0 mV/V 0.25 0.50 (<1k psi) 0.25 (all others) 0.10 0.35 (<1k psi) 0.25 (all others)	1.0 mV/V (<100k psi) 0.25 (<100k psi) 0.50 (all others) 0.25 (<100k psi) 0.50 (all others) 0.05 (<100k psi) 0.10 (all others) 0.10 (<100k psi) 0.15 (all others)	1.0 mV/V 0.25 0.35 0.10 0.25	1.0 mV/V 0.25 0.50 0.10 0.75
	−50 to +425 +15 to +425 0.5 0.5	−30 to +150 (<100 k psi) 0 to +150 (all others) +15 to +115 0.5 0.5	−30 to +425 +15 to +425 1.0 0.5	77 to +600 77 to +500 1.0 1.0
	12 V (dc or ac)	6 V (dc or ac)	6 V (dc or ac)	6 V (dc or ac)

Differential Pressure Transducers

Models are available for measurement of differential pressures from ±20 inches H_2O to ±3,000 psi at line pressures up to 5,000 psi. All models contain precision strain gages bonded to a stiff internal diaphragm between the two pressures being sensed. Thus, all BLH differential pressure transducers have the same performance qualities as BLH single-input pressure transducers... accuracy, stability, long life, infinite resolution.

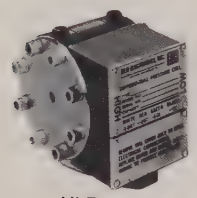
Models in the HLD series resolve extremely low pressure differentials and are recommended for critical flow measurements. (Some HLD transducers have been built to accurately resolve differentials as low as ±1 inch H_2O... 0.036 psi... at line pressures up to 1,500 psi.)

The HLD transducers have a time constant shorter than 10 milliseconds to provide fast response in variable pressure applications. They can handle any pressure medium compatible with 300 series stainless steel.

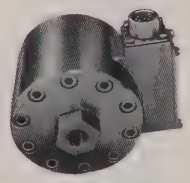
Models in the HMD series are designed for intermediate range pressure differentials. They can be used for measurements on any medium compatible with 17-4PH stainless steel.

Models in the HHD series are designed to measure large differentials at common line pressures up to 5,000 psi. They have high overload ratings... up to twice their differential pressure ratings. They are usable with any medium compatible with 17-4PH stainless steel.

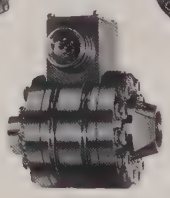
BLH also manufactures special differential pressure transducers which are optimized for specific applications. Obtain bulletin 402 for detailed data on all pressure transducers.



HLD



HMD



HHD

Differential Pressure Transducer Selection Chart

Series	HLD	HMD	HHD
	High line—low differential **Precise measurement of small differentials at full line pressure** **Fast response** **Diaphragm sensor** **350-ohm bridge**	**High line—medium differential** **All stainless steel** **Diaphragm sensor** **350-ohm bridge**	**High line—high differential** **All stainless steel** **Diaphragm sensor** **350-ohm bridge**
Specifications			
Full-Scale Differential Ranges Available	±20 to ±800 inches of H_2O	±50 to ±500 psid	±1000 to ±3000 psid
Max. Operating Line Pressure (psi)	1,500	5,000	5,000
Rated Output (RO)*	3.0 mV/V	2.0 mV/V	3.0 mV/V
Calibration Accuracy (% of RO)	0.25	0.50	0.50
Nonlinearity (% of RO)	0.50	0.25	0.25
Repeatability (% of RO)	0.10	0.10	0.10
Hysteresis (% of RO)	0.25	0.15	0.10
Safe Operating Temp Range (°F)	0 to +200	0 to +200	0 to +200
Compensated Temp Range (°F)	+25 to +175	+30 to +130	+30 to +130
Temp Effect on Zero Bal (% of RO/100°F)	1.0	0.5	0.5
Temp Effect on RO (% of RO/100°F)	1.0	0.5	0.5
Recommended Excitation	12 V (dc or ac)	10 V (dc or ac)	10 V (dc or ac)

*Set at +77°F

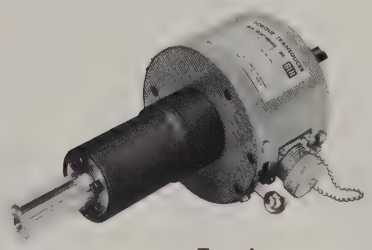
Torque Transducers

BLH torque transducers produce an electrical output proportional to static and dynamic torque. Measurements do not affect the speed or the torque of the mechanical system on which the measurements are made...and accuracy is completely independent of speed.

The torque transducers are connected in a line of shafting and torsion strain in the transducer shaft is sensed by precision strain gages to produce the electrical output. The gages are mounted on the transducer shaft such that their response to bending and thrust strains is negligible. Characteristics of gages and shaft are closely matched to insure stable accuracy over a wide operating temperature range.

Type A torque transducers are complete, self-contained units. Their torque sensing shaft is ball-bearing supported and is permanently fixed to, and aligned with, the outer electrical pickup (brush) assembly. Type A transducers are easy to install. They are designed for use in temporary test and measurement setups.

The transducers have brush lifting devices to eliminate brush wear when measurements are not being made. For detailed data, obtain BLH bulletin 518.



Type A

Torque Transducer Selection Chart

Series	TYPE A
	Complete unit...integral torque sensing shaft with bearings and brush assembly **Easy to install** **Best for temporary measurement setups** **350-ohm bridge**
Specifications	
Full-Scale Ranges Available (in.-lb.) **Maximum Speed (rpm)**	10 to 75,000 in.-lb. 3,600 (<50 in.-lb.) 7,000 (100 to 1k in.-lb.) 5,000 (2k to 30k in.-lb.) 3,500 (all others)
Rated Output, RO* (mV/V) **Calibration Accuracy (% of RO)** **Nonlinearity (% of RO)** **Repeatability (% of RO)** **Hysteresis (% of RO)**	1.5 0.25, CW or CCW 0.10 (<50 in.-lb.) 0.05 (all others) 0.05 0.15 (<100 in.-lb.) 0.05 (all others)
Safe Operating Temp Range (°F) **Compensated Temp Range (°F)** **Temp Effect on Zero Bal (% of RO/°F)** **Temp Effect on RO (% Torque/°F)**	–50 to +140 0 to +140 0.0025 0.005
Recommended Excitation	12 V (ac or dc)

*at +77°F

Load Cells...General Purpose...Precision...High Temperature

BLH load cells are precision transducers for measurement of weight and other linear forces. They contain strain gages bonded to internal load bearing structures which are stressed by applied tension or compression forces. The strain gages produce electrical outputs which are proportional to applied force.

BLH load cells offer the inherent advantages of all strain gage devices...excellent stability, accuracy, reliability and infinite resolution. They contain no moving parts . . . no fluids or seals. They are available with full-scale load ranges to over 1.5 million pounds for such diverse applications as:

- Material and vehicle weighing
- Tensile strength testing and cable tension measurement
- Batch and ingredient control in automated processing systems
- Mill roll pressure control
- Engine thrust measurement

The load bearing elements in standard models are magnaflux tested, high strength steel designed for uniform, repeatable stress distribution where the strain gages are bonded. The gages are matched to the load structure characteristics and are electrically balanced for exact temperature compensation...to maintain accuracy over a broad operating temperature range.

Full load deflection is extremely small...less than 0.012 inch for most standard models...as small as 0.002 inch for some special-purpose models. Small deflection, low mass design and absence of moving parts give all BLH load cells excellent high frequency response for dynamic force measurements.

Standard models are available with one strain gage bridge or with two identical, independent bridges for redundancy should one bridge ever fail. (Cells may be ordered with more than two bridges if required by an application.) All cells are hermetically sealed. They are individually calibrated and proof tested to full rated capacity (to over capacity in most cases).

Cells specified for tension service are calibrated in tension, but all may be used to full load in compression...with nearly equal performance in most cases.

General Purpose...Precision...High Temperature Load Cell Selection Chart

Series	U3G1 and U3G2	C3P1 and C3P2B	T3P1 and T3P2B	
Specifications	**General purpose** **Universal service...tension or compression** **U3G1...single 350-ohm bridge** **U3G2...dual 350-ohm bridge**	**Precision** **Accuracy of 0.10%** **Calibrated in compression but nearly equal performance in tension** **C3P1...single 350-ohm bridge** **C3P2B...dual 350-ohm bridges**	**Precision** **Accuracy of 0.10%** **Calibrated in tension but nearly equal performance in compression** **T3P1...single 350-ohm bridge** **T3P2B...dual 350-ohm bridges**	
Full-Scale Ranges Available (lb.)	20 to 10,000 (U3G1) 50 to 250,000 (U3G2)	50 to 10,000 (C3P1) 50 to 250,000 (C3P2B)	50 to 10,000 (T3P1) 50 to 250,000 (T3P2B)	
Rated Output, RO* (mV/V)	3.0	3.0	3.0	
Calibration Accuracy (% of RO)	0.25	0.10	0.10	
Nonlinearity (% of RO)	0.25 (<30 lb.) 0.10 (50 lb.-10k lb.) 0.05 (all others)	0.05 (except <300 lb. in tension = 0.10)	0.05 (except <300 lb. in compression = 0.10)	
Repeatability (% of RO)	0.10 (<30 lb.) 0.05 (50-300 lb.) 0.02 (all others)	0.05 (<300 lb.) 0.02 (all others)	0.05 (<300 lb.) 0.02 (all others)	
Hysteresis (% of RO)	0.10 (<30 lb.) 0.05 (50-300 lb.) 0.02 (all others)	0.05 (<300 lb.) 0.02 (all others)	0.05 (<300 lb.) 0.02 (all others)	
Creep (% of RO)	0.10 (<30 lb.) 0.05 (50-300 lb.) 0.03 (all others)	0.05 (<300 lb.) 0.03 (all others)	0.05 (<300 lb.) 0.03 (all others)	
Safe Operating Temp Range (°F)	−30 to +175	−30 to +175	−30 to +175	
Compensated Temp Range (°F)	+15 to +115	+15 to +115	+15 to +115	
Temp Effect on Zero Bal (% of RO/°F)	±0.0025	±0.0015	±0.0015	
Temp Effect on RO (% load/°F)	±0.005	±0.0008	±0.0008	
Recommended Excitation	12 V (dc or ac)	12 V (dc or ac)	12 V (dc or ac)	

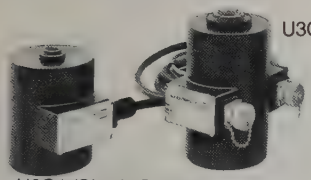
*Set at +77° F

Cells specified for compression service are calibrated in compression, and some of these cells may also be used in tension with equal performance. Cells specified as general purpose are intended for universal service...with both tension and compression loads.

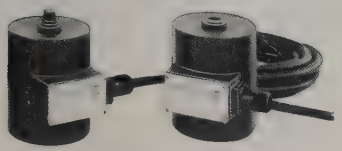
Precision cells have tighter specification accuracy, temperature compensation and other parameters than the general purpose cells.

High temperature cells have special materials, design and fabrication/compensation techniques to insure long term stability and accuracy at temperatures up to +450°F.

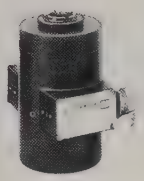
A number of special-purpose load cells are described on pages 18 and 19. For detailed data on all load cells, obtain BLH bulletin 401.


U3G2 (Dual Bridge)

U3G1 (Single Bridge)


C3P1 T3P1

C2P1


T2P2

U3G1-H

C2G1-H

	C2P1	T2P1	U3G1-H	C2G1-H and T2G1-H
	Precision **High capacity models to 1,500,000 pounds** **Compression only** **Single 350-ohm bridge... dual bridge units available**	**Precision** **High capacity models to 1,500,000 pounds** **Calibrated in tension but nearly equal performance in compression** **Single 350-ohm bridge... dual bridge units available**	**High temperature** **Version of U3G1 series for continuous duty to +450°F** **Universal service...tension or compression** **Single 350-ohm bridge**	**High temperature, high capacity** **Continuous duty to +450°F** **C2G1-H...compression loading models to 200,000 pounds** **T2G1-H...tension loading models to 200,000 pounds** **Single 350-ohm bridge**
	20,000 to 1,500,000	20,000 to 1,500,000	500 to 10,000	20,000 to 200,000
	2.0 0.10 (< 1m lb.) 0.25 (all others)	2.0 0.10 (<300k lb.) 0.25 (all others except 1.5m lb. = 0.50)	3.0 0.25 Ca room temp	2.0 0.25 Ca room temp
	0.05 (>1m lb.) 0.03 (all others)	0.05	0.10	0.20
	0.02 (>1m lb.) 0.01 (all others)	0.02	0.10	0.10
	0.02	0.02	0.10	0.10
	0.020 (>1m lb.) .015 (all others)	0.02	0.10	0.10
	−30 to +175 +15 to +115 ±0.0015 ±0.0008	−30 to +175 +15 to +115 ±0.0015 ±0.0008	+15 to +450 +15 to +425 ±0.0025 ±0.005	+15 to + 450 +15 to +425 ±0.0025 ±0.005
	10 V (dc or ac)	10 V (dc or ac)	12 V (dc or ac)	12 V (dc or ac)

Special-Purpose Load Cells...Low Profile...Miniature...High Output...Ruggedized...120-Ohm and 350-Ohm Bridges Ultralow...Capacity...Beam Type

The load cells on these pages have special designs and performance features.

Low profile cells (U3L1, U3L2) provide tension and compression service where space is limited. They are immune to adverse side loads (up to 100% of rated axial load capacity) and to adverse bending moments (up to 50% of rated axial load capacity in inch -lb.). They have a high fatigue life. Deflection is less than 0.005 inch at full load. Natural frequency is greater than 10 kHz for models up to 10,000 pounds capacity. These cells are ideal for dynamic/static force measurement and for fatigue life tests.

Miniature cells (U2M1, C2M1, C2M1C) are extremely small for their load ratings...only 2 inches diameter by 1.5 inches long for compression models up to 5,000 pounds capacity. They have low deflections... less than 0.006 inch...and are immune to relatively severe side and eccentric loads. For complete data obtain BLH bulletin 401.

High output cells (USG1) contain semiconductor strain gages and produce a 1-volt full-scale output. They can directly drive long cable runs and many indicators without need for special signal conditioning or amplification.

Ruggedized cells (C1R1H and CSR1) are designed for maximum durability in very severe environments. They will survive overloads up to 500% of rated capacity and have all-welded, all-stainless steel construction. The C1R1H models may be used in continuous duty to +400°F. The CSR1 models have semiconductor strain gages to produce a 1-volt output...and may be used in continuous duty to +200°F.

The 120-ohm bridge models (U1, C, CXX) are used primarily as replacements for 120-ohm load cells in existing systems and for expansion of existing systems. For complete data on 120-ohm cells, obtain BLH bulletin 401.

Special-Purpose Load Cell Selection Chart

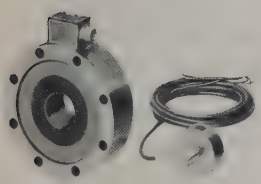
Series	U3L1 and U3L2	U2M1, C2M1, C2M1C	USG1
	Low profile **Universal service...tension and compression** **Accurate even with adverse side and eccentric loads** **High fatigue life** **U3L1...single 350-ohm bridge** **U3L2...dual 350-ohm bridge**	**Miniature** **High immunity to adverse loads** **Small deflection** **High frequency response** **U2M1...universal, tension or compression** **C2M1...compression only** **C2M1C...high capacity compression only** **Single 350-ohm bridge**	**High output** **One-volt at full-scale** **Universal service...tension and compression** **Small deflection** **Extreme overload protection** **Single 350-ohm bridge**
Specifications			
Full-Scale Ranges Available (lb.)	5,000 to 500,000	100 to 5,000 (U2M1 & C2M1) 10,000 to 200,000 (C2M1C)	250 to 100,000
Rated Output, RO*	3.0 mV/V	2.0 mV/V	1 volt
Calibration Accuracy (% of RO)	0.25 (accuracy to 0.10 available)	0.25 (C2M1, C2M1C) 0.50 (U2M1)	0.25
Nonlinearity (% of RO)	0.10	0.15	0.35
Repeatability (% of RO)	0.02	0.05	0.05
Hysteresis (% of RO)	0.10	0.10	0.10
Creep (% of RO)	0.05	0.03	0.05
Safe Operating Temp Range (°F)	−65 to +200	−30 to +150	−20 to +170
Compensated Temp Range (°F)	+15 to +115	+15 to +115	+30 to +130
Temp Effect on Zero Bal (% of RO/°F)	±0.0025 (±0.0015 available)	0.0025	±0.0025
Temp Effect on RO (% load/°F)	±0.0025 (±0.008 available)	±0.005	0.005
Recommended Excitation	12 V (dc or ac)	12 V (C2M1, U2M1) 18 V (C2M1C)	12 Vdc

***Set at +77°F** ****Combined nonlinearity and hysteresis**

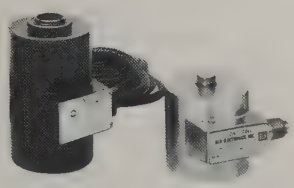
Beam load cells (LBP1) are very small devices particularly suited for use in platform scales and similar weighing devices. The cells sense force loads by measuring the bending strain in a machined steel beam which has the load at one end and is constrained at the other. This design offers high accuracy (to 0.10% of rated output) plus excellent immunity to adverse side, eccentric and thrust loads.

Ask for catalog 403 for details on complete Line of Load Beams.

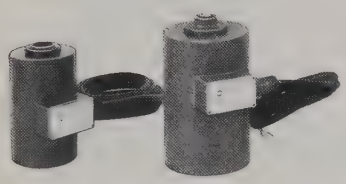
Besides the cells listed here, BLH has developed many other types for very high temperature corrosive environments...vacuum...deep ocean work. Special cells have been manufactured with load capacities up to 12 million pounds. Call or write for information on models for special uses and models built to custom requirements. Obtain BLH bulletin 401 for detailed data on the complete family of standard and special-purpose models.



U3L1 C2M1



USG1 C1R1H



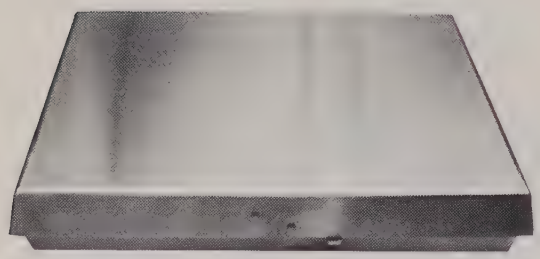
U1 CXX

LBP1

es	C1R1H and CSR1	U1 and C	CXX	LBP1
	Ruggedized **Designed for very difficult environments** **C1R1H...metallic strain gages...1 mV/V output** **CSR1...semiconductor strain gage...1 volt output** **Both series have single 350-ohm bridges**	**120-ohm, general purpose** **U1...universal service tension or compression** **C...compression only** **Replacements for cells used in existing 120-ohm, 2 mV/V systems**	**120-ohm, precision** **Accuracy of 0.10%** **Compression only** **Replacements for precision cells in existing 120-ohm, 2 mV/V systems**	**Beam load cells** **Small...design and form factor ideal for use in platform scales.** **High immunity to side, eccentric and thrust loads** **350-ohm bridge**
cifications				
Scale Ranges Available (lb.)	1,000 to 10,000	50 to 200,000 (U1) 2,000 to 200,000 (C)	500 to 200,000	50 to 10,000
d Output, RO*	1.0 mV/V (C1R1H) 1 volt (CSR1)	2.0 mV/V	2.0 mV/V	2.0 mV/V
bration Accuracy (% of RO)	0.25	0.25	0.10	0.25 (accuracy to 0.10 available)
inearity (% of RO)	0.25 (C1R1H) 0.35 (CSR1)	0.10 (U1 <2k lb.) 0.20 (U1 >2k lb.) 0.25 (C)	0.10 (<2k lb.) 0.20 (>2k lb.)	0.03
eatability (% of RO)	0.05	0.05	0.05	0.01
teresis (% of RO)	0.10	0.10 (U1) 0.25 (C)	0.05	0.02
ep (% of RO)	0.05 0.10 (C1R1H & CSR1)	0.10 0.15 (U1 & C)	0.08	0.01
Operating Temp Range (°F)	+400 (C1R1H) +250 (CSR1)	−30 to +175	−30 to +175	−20 to +175
pensated Temp Range (°F)	+15 to +350 (C1R1H) +50 to +150 (CSR1)	+15 to +115	+15 to +115	50 to +115
p Effect on Zero Bal (% of RO/°F)	0.005 (C1R1H) 0.0025 (CSR1)	±0.0025	±0.0015	±0.0015
p Effect on RO (% load/°F)	0.005	0.005	0.0008	0.0008
ommended Excitation	10 V (dc or ac) for C1R1H 16.6 Vdc for CSR1	6 V (dc or ac)	6 V (dc or ac)	12 Vdc

at +77°F ****Combined nonlinearity and hysteresis

Type PH platform transducer



Type PF platform transducer

Type PF with cover removed

Platform Transducers

Platform transducers by BLH provide a complete electronic weighing capability in fully-assembled, calibrated, ready-to-use form. The transducers produce instantaneous electrical outputs proportional to weight for: (a) readout by digital, moving pointer or scale indicator units located with the platform or at remote locations, (b) permanent data recording via digital printers, (c) control of other instrumentation and/or automated processing systems.

All models have an extremely rugged design. They are tough enough for round-the-clock use in shipping and receiving operations and in heavy equipment production facilities. Yet, they are accurate enough for laboratory and quality control weighing applications. Most models meet the full accuracy requirements for buy and sell weighing as specified in U.S. Bureau of Weights and Measures Bulletin H44.

TYPE PH models are for high weight applications up to 5,000 pounds full-scale. They provide accuracy of 0.10% . . . have a 4 x 4 foot weighing surface and a −15°F to + 150°F compensated temperature range.

TYPE LC is a smaller version (30 in. x 34 in.) of Type PH with a capacity of 1000 pounds.

TYPE PF platforms are designed for low weight applications, 100 and 1000 pounds full scale. They are constructed of type 304 stainless steel and can withstand a complete washdown without rust or corrosion. The 1000-pound unit is also available in mild steel. All are protected with overload stops for protection of scale and load cell.

Calibration Services

BLH provides high precision calibration services to owners and users of load cells. Calibration is performed in either tension or compression using equipment having guaranteed accuracy of 0.01% for loads up to 130,000 pounds and 0.025% up to 250,000 pounds.

To achieve this unique combination of accuracy and heavy load capability, BLH has constructed very large calibration systems employing dead weights calibrated and adjusted by the National Bureau of Standards. The BLH system is one of the world's largest dead weight calibrators.

BLH calibration services are available for:

- All strain gage load cells produced by BLH and other manufacturers.
- Hydraulic, mechanical and non-strain-gage electrical load cells, provided suitable readout/indication units are supplied with the load cells to be calibrated.
- Recalibration of BLH secondary standard force calibration systems (see page 42 & Product Data 620).

All load cells receive a thorough mechanical and electrical checkout before calibration. A written report and calibration certificate is issued for each load cell after calibration is completed.

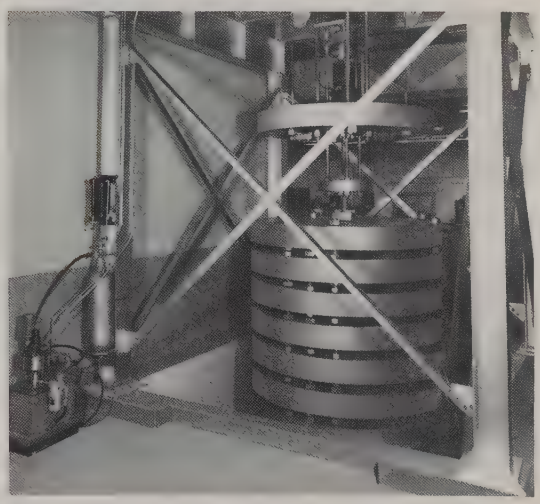
Custom Transducer Design

Design and manufacturing of special transducers for individual customer applications are major activities at BLH. A special engineering staff and facilities are maintained just for such projects.

Engineering assistance and transducer design services are available to any phase of a customer's program... from analysis of a basic physical measurement problem through quantity manufacturing of completed transducers having form, fit and function matched exactly to their user's end products. These capabilities can be supplied for all types of transducers... for measurement of pressure, force and weight, torque, linear position or angular position.

On a custom basis, BLH has designed and manufactured:

- Most pressure transducers used in the Hawk and Titan missiles.
- Torque transducers ranging from 24 inch-pounds capacity to over 1.5 million inch-pounds capacity.
- Unique load cells which mount on the wheels of hospital beds to measure the weight of bed and patient.
- Specialized transducers for aircraft and missiles where high volume production, low cost, and high reliability are required.
- Unique transducers which sense pressures related to aircraft pitch and roll, then activate flight control system boost forces in response to pilot's control stick motions.
- Transducers particularly designed for high pressure, underwater applications... for oceanographic work... for use in deep wells.
- Weight measuring load cells having individual capacities up to 12 million pounds.

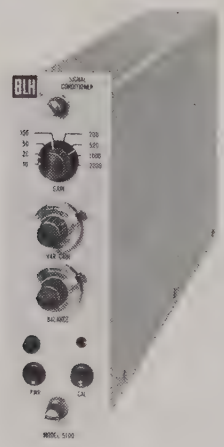


Calibration weights

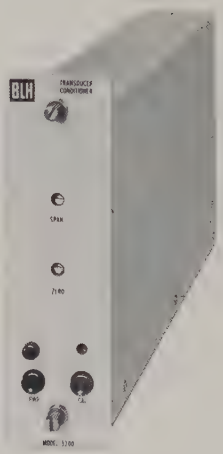
Force pin load sensing device for fork truck

Shown are two 5 million lb. load cells with a U3G1 general purpose load cell

Signal Conditioners...Series 5000



MODEL 5100
STRAIN GAGE
CONDITIONER

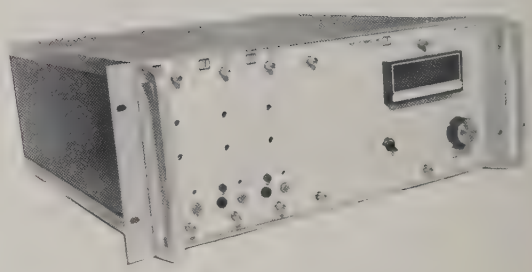


MODEL 5200
TRANSDUCER
CONDITIONER

The Series 5000 instruments have been designed by BLH to provide a line of compact plug-in instruments for process control systems and stress analysis. The Series 5000 instruments are available in single, stand-alone cabinets, four-across with readouts (analog or digital) and selector switching, or, in eight-across multichannel systems with or without readouts, printers, etc. in standard 19-inch relay racks. These modules contain power supplies for transducer excitation, bridge completion, signal conditioning and amplification. The units are capable of taking low-level signals from a variety of sources and drive oscillographic recorders, printers, or many other devices such as alarms, controls, etc.

The basic instrument consists of a preamplifier, an auto-zero triggering circuit and a regulated power supply. The standard unit is equipped with an active filter to eliminate cyclic or pulsing load-induced signals from the source device.

The Series 5000 Conditioners are compatible with all BLH transducers and sensors. Refer to Bulletin 627.



Rack Mounting with Model 5010 Switching Unit

Portable Digital Strain Indicator... Model 1200B

Model 1200B

- Advanced integrated circuit design with LED electronic digital readout
- Measures strains to ±100,000 microinches/inch ... displays gage factor and battery status
- Automatic zeroing cancels instrument zero drift
- BCD output available for printers and other instrumentation
- Peak and hold option—captures and holds highest level reached by time-varying signal.

The Model 1200B is a digital strain indicator with advanced features for laboratory and field applications. When X1 scale factor is selected, the instrument displays strains up to ±19,999 microinches/inch with resolution of 1 microinch/inch. With X10 scale factor, strains up to ±100,000 microinches/inch are displayed with resolution of 10 microinches/inch.

The Model 1200B offers a very wide gage factor range ... from 0.500 to 9.500. And, the gage factor is displayed on the digital readout with resolution of 0.001 while the gage factor controls are being set.

Full and ½ bridges of 60 to 2,000 ohms may be used with the Model 1200; ¼ bridges of 120 and 350 ohms may also be used. Amplified bridge output is available at a front panel jack for dynamic strain display on any standard oscilloscope or oscillograph. Dynamic output response is flat within ±10% from dc to 50 kHz. Analog output available at rear panel.

An optional BCD output feature is available for use with printers and other digital equipment. The BCD output lines are compatible with TTL logic. A data ready line is also supplied.

Both 115/230 Vac, 50 to 400 Hz, and rechargeable-battery models are available. A battery-check feature displays the status of battery output on the digital readout. A battery-saver feature conserves power between strain readings to give very long battery life.

For complete specifications, obtain BLH bulletin 608.

SPECIFICATIONS

Strain Ranges	0 to ±19,999 microinches/inch using X1 scale factor; 0 to ±100,000 microinches/inch using X10 scale factor
Accuracy Factors	
Linearity:	±0.04% of reading ±1 digit for full bridge having 4 active gages
Temp Effect on Zero:	±0.005% of range/°F
Temp Effect on Span:	±0.005% of range/°F
Resolution	1 microinch/inch using X1 scale factor; 10 microinches/inch using X10 scale factor
Gage Factor Range	0.500 to 9.500; settable to 0.001 resolution via display on digital readout
Gage Resistance Range	120 and 350 ohms for ¼ bridge circuits; 60 to 2,000 ohms for ½ and full bridge circuits
Bridge Excitation Supplied	4.8 Vdc

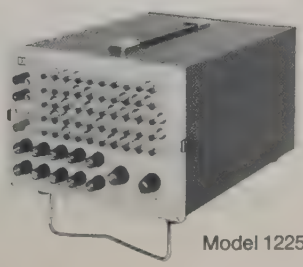
Switching and Balancing Unit... Model 1225

The Model 1225 is an accessory unit which allows up to 10 independent strain gage channels to be individually balanced and manually switch-selected for readout by a single Model 1200 indicator. Several Model 1225 units may be interconnected if more than 10 independent channels are required.

Selection switch contact resistance is extremely low. Thus, measurement repeatability is better than 1.0 microinch/inch for 500,000 switch rotations. Balancing controls have a special friction drive which requires no locking when set.

The Model 1225 will handle intermixed ¼, ½ and full bridges. The full bridges may be 60, 120, 350, 500 and 1000 ohms. The half bridges may be 60 to 2,000 ohms.

For complete specifications, obtain BLH bulletin 608.



Model 1225

Low-Cost Digital Strain Gage Scanning System Model 12000

- A modular, inexpensive data acquisition system... designed for add-on expansion as needed
- Automatically scans up to 100 strain gage or transducer channels
- Measures strains up to ±100,000 microinches/inch
- Prints hard copies of all measured data
- Uses high performance channel switching design for repeatability better than 1 microinch/inch

The Model 12000 is a low-cost scanning system which automatically measures, displays and prints data from multiple strain gage or transducer channels. The system can be configured with up to 100 channels (standard) or 200 channels (special) by adding modular 10-channel scanning units as needed. The system is designed for those who often require quantities of accurate stress data but do not need the full capacity of a really large scanning installation. The packaging is designed to allow the system to be configured in small enclosures for ease of portability.

A BLH Model 1200 indicator (page 23) is used as the basic measurement unit. The indicator's advanced performance capabilities are maintained by design of the scanning modules which have extremely low, stable contact resistance for measurement repeatability better than 1 microinch/inch over 500,000 scanning cycles.

Strain measurements up to ±19,999 microinches/inch are made with resolution of 1 microinch/inch. Measurements up to ±100,000 microinches/inch are made with resolution of 10 microinches/inch. Automatic zeroing circuits prevent any instrument zero drift.

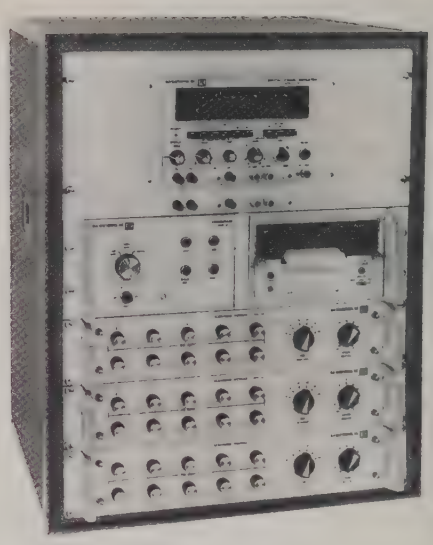
Hard copy printouts are produced for all measured data in 10-column format or in 21-column format (optional). The 10-column printout contains channel identification, polarity, five data columns and an X1 or X10 scale factor range indication. The 21-column printout adds day, hour and minute when the data is taken.

Full, ½ and ¼ bridges can be handled by the system. The full and ½ bridges may be 60 to 2,000 ohms. The ¼ bridges may be 120 or 350 ohms. Individual zero balance adjustments are provided for each channel; range of zero adjustment is ±7000 microinches/inch.

The system can be set for gage factors from 0.500 to 9.500. Gage factors are displayed on the digital indicator with resolution of 0.001 while being set.

A front panel output jack allows dynamic strain signals from a single channel to be viewed on an oscilloscope.

For complete specifications, obtain BLH bulletin 609.



Model 12000

SPECIFICATIONS

Strain Range	0 to ±10,000 (overranging to ±19,999) microinches/inch with resolution of 1 microinch/inch using X1 scale factor; 0 to ±100,000 microinches/inch with resolution of 10 microinches/inch using X10 scale factor
Accuracy Factors	
Linearity:	±0.04% of reading ±1 digit for full bridge having 4 active gages
Temp Effect on Zero:	±0.005% of range/°F
Temp Effect on Span:	±0.005% of range/°F
Gage Factor Range	0.500 to 9.500
Printout	10-column channel data or 21-column channel data plus time data
Scanning Modes	continuous through all channels; continuous through groups of channels; single scan through all or some channels; manual selection of individual channel
Scanning Rate	approximately 1 channel per second

Computer-Based Data Acquisition System...Model 6000

- A multichannel, computer-based scanning system with full processing of all acquired data
- Scans up to 1024 channels of strain gages, temperature sensors or transducers...intermixed ...in any combination.
- Handles mV/V or mV inputs...any gage factor or bridge configuration...applies proper calibration/ scaling factors to each channel
- Automatically zero balances all channels
- Prints out fully processed results, not just raw data.

The Model 6000 is a totally computer-based, multichannel scanning system for strain gages, temperature sensors and transducers. The central computer not only controls the channel scanning functions, it automatically calibrates and zero balances all input channels. Over 500 channels can be balanced in less than 4 minutes. And, only one span adjustment is required for the entire system. Individual channel span adjustments/calibrations are performed by software.

The system computer also processes the inputs from all channels scanned and prints out results in any desired form:

- As raw data (millivolts)
- As scaled data (engineering units)
- As calculated results of software processing routines (stress magnitudes and directions from rosette gage measurements...or linearized temperatures from thermocouple and resistance thermometer measurements, for example)

The Model 6000 is programmed to furnish final, processed answers...not just raw data alone.

The system is completely modular and expandable. Each scanning module comprises 16 or 32 input channels. Modules can be added up to a maximum capacity of 1024 channels.

The channels can be intermixed strain gages, temperature sensors and transducers in any combination. Any channel can be ¼, ½ or full bridge... any type of mV/V or mV input...any gage factor, sensitivity or rated full-scale capacity. Proper calibration/scaling/correction factors are automatically applied to data from each channel in the Model 6000 computer.

Individual data limits can be specified for all channels. When the data from a channel exceeds the limits for that channel, the printout is flagged and/or an alarm is sounded. All printouts may contain the time of day when measurements were taken.

The scanning modules may be operated at locations remote from the mainframe. Thus, large quantities of expensive instrumentation cable can be saved in many applications.

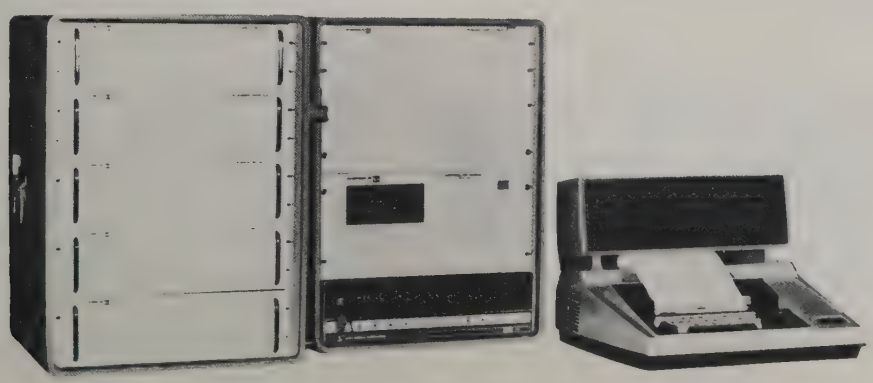
A standard teletype unit is used for printouts and for operator instruction input to the system. Other input devices may be used for cassette tape recording of data. A BCD output can also be made available for use by an external high speed printer or other digital device.

The basic software package for the Model 6000 is designed for maximum operational simplicity. Man/ machine interface routines in the software guide all operator functions in a conversational manner. Via the teletype I/O unit, the system asks what operations are desired. The operator responds by answering the requests in a simple conversational manner using the teletype keyboard. The system will not accept improper operator entries. The operator never touches the computer controls during normal use of the system.

The operator designates the channels to be scanned by the system; channels not designated are skipped. The operator also designates: (a) scan rate, (b) time delay desired between scans and (c) whether scanning is to be continuous or once-only.

The processing/scaling/calibration factors for each channel are also specified by the operator, and he designates the type of printout desired. He may request: (a) a list of all active channels and their instructions, (b) a list of all raw or processed data from active channels, (c) a list of only channels out-of-limit and (d) many other formats.

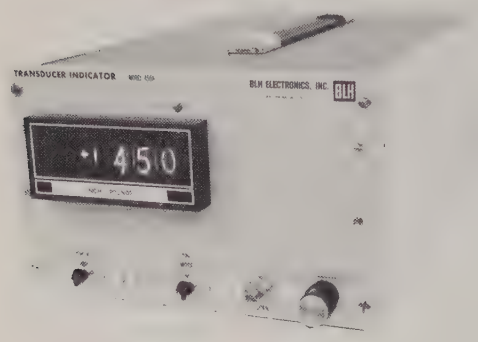
Specifications available on request. Bulletin 621.



Model 6000

Low-Cost Transducer Indicator/Signal Conditioner Model 450

- A basic signal conditioning mainframe with multiple readout, processing and control options
- Fully automatic electronic zeroing continuously cancels any instrument zero drift
- Excitation output sufficient for up to eight transducers



BLH Model 450 Transducer Indicators for strain gages are furnished with either a digital readout (above) or a meter readout (below). The first low-cost transducer indicator for the process control field, it offers many options to the user. Introduced on the instrument for the first time is a new peak-and-hold circuit and automatic tare cancellation.

Model 450 shown with Model 460 Rate by Weight Indicator

The Model 450 is a building-block signal conditioning unit for use with all types of strain gage transducers. The basic mainframe can be configured with any of numerous modular options to form at low cost... readout and signal conversion equipment tailored to exact needs... even complete instrumentation for process control systems of modest proportions.

By itself, the mainframe is a complete signal conditioner to which a user may attach his own indicating devices for readout of measured parameters. Or, the mainframe may be used as a preamplifier for oscilloscope display of dynamic parameters.

By adding a BLH meter or digital readout option, the Model 450 becomes a completely self-contained transducer indicator capable of displaying measured parameters directly in engineering units.

Setpoint options may also be added to the mainframe, with or without the readout options, to form a controller which will initiate contact closure whenever a measured parameter reaches preset limits. Other options provide for current output compatible with many process control instruments... and for BCD data output compatible with hard copy printers and other digital instrumentation.

The mainframe contains a regulated 10 Vdc power supply with current output sufficient for excitation of eight 350-ohm or four 120-ohm full bridge transducers. The mainframe also contains essential signal processing circuits for the transducer output... filtering, amplification, automatic and manual zeroing, plus necessary operator controls. Full-scale transducer outputs as small as ±0.5 mV/V will produce a mainframe full-scale output of ±5 V.

For complete specifications on the Model 450 and its options, obtain BLH bulletin 450.

OPTIONS FOR MODEL 450

Digital Panel Meter Readout . . . displays value of quantity being measured by mainframe electronics. Has three digits plus "1" overrange and automatic polarity indication. Provides ±0.1% of full-scale accuracy. Also available with 3¾ digit (3999) and 4½ digit (19999) readouts. 0.5" LED display also available.

Analog Meter Readout... indicates value of quantity being measured by mainframe electronics. Standard 4½" rectangular moving coil meter accurate to ±1% of full scale. Different scales and legends available.

Analog Meter Readout With Setpoints... standard 4½" rectangular moving coil meter having two setpoints (for high and low limits) adjustable from front panel. Contact closures initiated when meter pointer reaches either set pointer.

Internal Setpoints... provides two setpoints (for high and low limits) internally adjustable over 0 to

100% of full scale range. Contact closures initiated when measured parameter reaches either preset level.

Single Front Panel Thumbwheel Setpoint... operator adjustable setpoint initiates contact closure whenever measured signal reaches the set level.

Dual Front Panel Thumbwheel Setpoints... two operator adjustable setpoints (for high and low limits) which initiate contact closures when measured signal reaches the set levels.

Current Output... converts mainframe voltage output to a current output for use by current-driven process control equipment and readouts.

BCD Data Output... converts signal level measured by mainframe to a BCD digital output compatible with DTL and TTL logic. Used to drive printers, tape punches and other digital instrumentation.

Dual Input Channels... allow operator selection of a second transducer channel for input to the mainframe.

Peak and Hold... captures and holds highest level reached by a time-varying signal for measurement by the mainframe electronics. (Extremely useful in measurement of instantaneous shock loads, starting torques, peak pressures and similar variables.)

Automatic Tare Cancellation... allows operator to cancel tare weight of containers and display only net weight of contents on the Model 450 equipped with indicator option.

High Speed Response... increases bandwidth of basic mainframe to 8 kHz (at 3 dB down) for applications requiring fast response to dynamic parameters.

COMPANION EQUIPMENT FOR THE MODEL 450

Model 905 Digital Indicator... digital readout accurate to ±0.01% of full scale when used with Model 450 mainframe. Displays up to 5 active digits ...one dummy digit available (see page 33).

Model 455 Channel Selector... manual channel selection switch unit permits multiple Model 450 signal conditioners to be read out on one digital display .

Model 460 Rate By Weight Indicator ...
operates with Model 450 to monitor material flowing from load cell supported vessel. Change in load occurring within preselected update times is translated into flow in pounds per hour.
Alarm/control setpoint options — bench, panel or rack mounting. For details on Model 460, refer to bulletin 624.

Model 980 and 981 Setpoints... setpoint modules with advanced process control features... provision for two-step main and dribble fill control... compensation for in-flight materials (see page 34).

Junction Boxes and Cables... standard and explosion proof junction boxes for joining cable runs... for summing transducer outputs before application to Model 450 mainframe (see page 39).

SPECIFICATIONS

Input Signal Level	minimum ±0.5 mV/V for full-scale output; maximum ±3.0 mV/V for full-scale output
Analog Output Voltage	0 to ±5 Vdc @ 2.5 mA, filtered
Accuracy	±0.01% of full scale basic mainframe accuracy with Model 905 Digital Indicator; ±0.1% of full scale with digital panel meter option; ±1.0% of full scale with analog meter option
Linearity	±0.02%
Temp Effect on Zero	±0.25 uV/°F (referred to input)
Temp Effect on Span	±0.002% of reading/°F
Response To Step Input	2 seconds to 99.9% for analog output voltage; 3 seconds to 99% for meter indication
Frequency Response	dc to 8 kHz with high speed option
Transducer Excitation Supplied	10.0 Vdc ±0.1% regulated @ up to 350 mA

Model 450 shown with Model 455 switching and balancing unit

Model 450 with dual setpoint option

Digital Transducer Indicators Models 8000, 8000SW, 8000ST

- Advanced design with accuracy of ±0.01%
- Resolution of 1 part in 10,000...overranging to 1 part in 20,000
- Completely self-contained...performs all signal conditioning, readout and excitation functions
- Displays measured parameters in engineering units...up to full-scale maximum of ±999,996
- Extremely wide selection of add-on options and companion equipment for modern system applications

The Model 8000 is an advanced transducer indicator/signal conditioner designed for use as the central element of modern measurement and control systems employing strain gage transducers. The instrument provides instantaneous digital readout of measured parameters with accuracy of ±0.01%... resolution of 1:10,000 (with overranging to 1:20,000). Parameters are displayed directly in engineering units...pounds, tons, psi, foot-pounds and so forth. No unit conversions are required of an operator.

With digital multiplier option, the basic unit's full-scale display range of ±10,000 can be multiplied by 2, 3, 4...up to 9. Thus, full-scale engineering unit displays from ±20,000 to ±90,000 are easily implemented...while retaining the 1:10,000 resolution inherent in the basic instrument. For applications requiring full-scale engineering unit displays from ±100,000 to ±900,000, an optional dummy zero digit can be added in the least significant digit position.

The Model 8000 indicators achieve their exceptional accuracy and long-term stability by design. A special analog-to-digital conversion technique eliminates span errors which could ordinarily result from component variation and aging, from temperature fluctuations, and from thermocouple effects. This technique also provides excellent rejection for 60 Hz line frequencies. And, electronic zeroing circuits continuously cancel any instrument zero drift.

The built-in bridge excitation power supply is precisely regulated and employs remote sensing to maintain exactly constant voltage at the transducers even when long cable runs are used between the transducers and the Model 8000. Excitation current is sufficient for up to eight 350-ohm or four 120-ohm full bridge transducers.

Many options and companion instruments are available to expand and complement the capabilities of Model 8000 indicators in system applications. An automatic zero tracking option automatically rezeros an entire system...transducers and instrumentation ...every time a no-load condition exists at the transducers.

A horsepower option allows the Model 8000 to monitor both rpm and torque, perform required computations and display horsepower directly on the digital readout. Advanced setpoint modules can be added to monitor the Model 8000 analog output and form a

Model 8000

precision controller for weighing, batching, filling and other process control operations.

For complete specifications, obtain BLH bulletin 619.

OPTIONS FOR MODEL 8000

Digital Multiplier...multiplies basic ±10,000 full-scale range by integer from 2 thru 9 while retaining 1 part in 10,000 resolution. Provides full-scale ranges from ±20,000 to ±90,000. Example: full weight of a 50,000 pound tank can be displayed using X5 multiplier...the digital readout will range from 00000 to 50,000 pounds in increments of 5 pounds.

Dummy Zero...constant zero numeral used in least significant digit position to provide displays in engineering units of ±100,000 or more...a dummy sixth digit.

Least Significant Digit...forces digital display to change in least significant digit steps of 2 or 5 rather than 1. Avoids unnecessary, annoying display changes in applications where input signals fluctuate about an average value.

Electronic Lowpass Filter...3-section plug-in filter provides increased integration for input signals to minimize effects of transient, fluctuating or pulsating parameters...shows longer period average for parameter value than available without filter...pass-band is dc to 1.0 Hz. Indicator response time with filter is 3 seconds to reach 99.9% of final reading.

BCD Data Output...makes measured parameter values available as BCD data compatible with TTL logic for use by printers, computers and other digital instrumentation. Data ready line is also provided.

Current Output...makes measured parameter values available as current values for use by current-controlled devices...recorders, indicators and other process control instrumentation. Three full-scale current ranges available.

Bridge Linearization... permits adjustment of Model 8000 linearity characteristics in a direction which compensates for transducer non-linearity... allows exact matching of indicator and transducers to obtain *total system accuracy* of 0.05%, even with transducers having non-linearity as high as ±0.25% of full scale.

Internal Setpoints... provides two setpoints (for high and low limits) internally adjustable over a 0 to 100% of full-scale range. Contact closures initiated when measured parameter reaches either limit set.

Horsepower Readout... used with strain gage torque transducer and an rpm pickup to provide direct readout of horsepower on the Model 8000 digital display.

Automatic Zero Tracking... electronically rezeros the entire system... transducers, cables, instrumentation... every time a no-load condition exists at the transducers. Maintains accuracy of total system by cancelling zero drift.

COMPANION EQUIPMENT

Model 980 and 981 Setpoints... setpoint modules with advanced process control features... provisions for two-step main and dribble fill control... compensation for in-flight materials (see page 34).

Model 826A and 827 Switching, Balancing Units... permit a number of identical transducer channels to be read out by a single Model 8000SW indicator (see page 30).

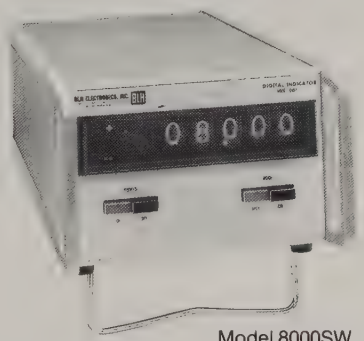
Model 4000 and 4500 Programmable Transducer Switching Units... permit a number of different transducer channels... having different transducer types, quantities, capacities, calibrations... to be read out by a single Model 8000SW indicator (see page 31).

Digital Printers... provide permanent hard copy printouts of measured data in tape or ticket format. Available in several versions, including models which add a time code to all printed data.

Junction Boxes and Cables... standard and explosion-proof junction boxes for joining cable runs... for summing transducer outputs (see page 39).

SPECIFICATIONS

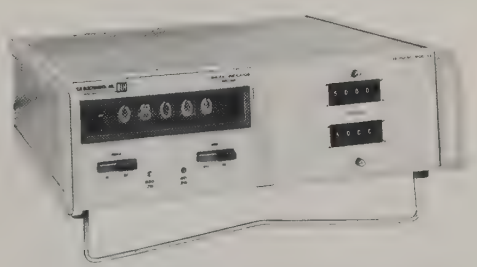
Input Signal Level	minimum ±1.0 mV/V for full-scale readout = ±10,000 counts (1 microvolt per count referred to input); maximum ±3.0 mV/V for full-scale readout
Digital Readout	0 to ±10,000 full scale without multiplier option; overranging to ±20,000
Analog Output Voltage	0 to ±5 V; accuracy of ±0.02%
Resolution (Maximum)	1 part in 20,000
Accuracy	±0.02% of reading ±1 count
Linearity	±0.01% ±1 count
Temp Effect on Zero	±0.001% of full scale/°F or ±0.25 μV/°F, whichever is greater
Temp Effect on Span	±0.002% of reading/°F
Bridge Excitation Supplied	10.0 Vdc @ 350 mA regulated, with remote sensing (5.0 Vdc and 15.0 Vdc also available)



Model 8000SW

MODEL 8000SW

The Model 8000SW is identical to the basic Model 8000 indicator but has no bridge zeroing or span adjustment controls. The Model 8000SW is intended for use with multichannel transducer switching and balancing units having controls for independent balancing and span adjustment of each transducer input channel. (See switching and balancing models 826A and 827 on page 30; also see programmable switching unit Model 4000 on page 31.)



Model 8000ST shown with setpoint module

MODEL 8000ST

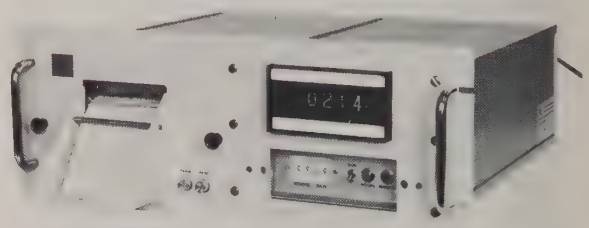
The Model 8000ST is a modified version of the basic Model 8000 indicator. The Model 8000ST is intended for use with digital tare cancellation and net weight-controlled setpoint units. (See digital tare cancellation and control setpoint Models 980 and 981 on page 34.)

Printers...Tape and Ticket

- Up to 21 columns — Tape
- Up to 18 columns — Ticket
- Compatible with BLH solid-state instruments — BCD INPUT
- Bench, Rack, or Panel Mounting

BLH Tape Printers, Models 4550 and 8050, operate with BLH Indicators, series 450 and 8000. The tape printers are compact, rugged, designed for laboratory and industrial environments. Both models have clock and calendar recording options as well as storage. Printout is 2.8 lines per second with 21 column capacity. Standard print drum has 16 positions per column and prints up to 50 different characters, alpha-numeric and symbols.

BLH Ticket Printers, Model TP-900-18, will process an unlimited variety of tickets, cards, or pages, without requiring redesign of the unit, through the use of a fully accessible print platen. These printers provide up to 18 columns with automatic printout with ticket insertion. The printer prints up to 7 legible copies with optional time and date in combination with data columns.



TAPE Model 8050

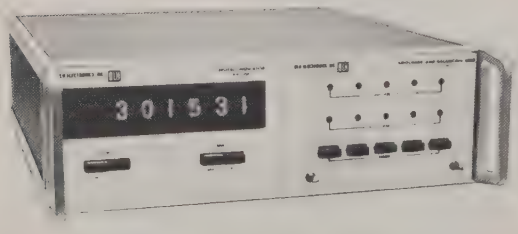
Switching and Balancing Units ... Models 826A, 827

- For manual switching between transducer channels having identical characteristics
- Individual zero and span controls for each channel

Models 826A and 827 are manual switching and balancing units which permit a number of identical transducer channels to be read out by a single Model 8000SW indicator. Front panel controls on the switching and balancing units provide for:

- Independent zero balancing of each channel
- Independent span adjustment of each channel
- Operator selection of the particular channel to be read out by the Model 8000SW indicator

Model 826A



Model 827 shown with Model 8000 digital readout

The combination of Model 8000SW and one or more 826A/827 switching and balancing units can be used to form simple, inexpensive multi-channel measurement systems whenever all transducer channels in the system are identical. That is, all channels must have the same full-scale capacity and output characteristics since they will be displayed with the same scale-factor by the Model 8000SW indicator. Each channel may be the output of a single transducer or the summed output of several transducers, but all channels must be the same.

For multi-channel systems having more than one type of transducer channel, the Model 4000 programmable transducer switching unit should be used with the Model 8000SW indicator as described on the facing page.

MODEL 826A

The Model 826A is a 10-channel switching and balancing unit. It has built-in provisions for interconnection with other 826A units to provide more than 10 channels capacity as required.

Each channel selected is identified by a BCD output on the rear panel.

Obtain BLH bulletin 619 for detailed specifications.

MODEL 827

The Model 827 is a 5-channel switching and balancing unit with essentially the same characteristics as the Model 826A, but for smaller system applications. The Model 827 has push-button channel selection and it provides a BCD output which identifies the channel selected.

For detailed specifications, obtain BLH bulletin 619.

Programmable Transducer Switching Units Models 4000, 4500

- For manual or remotely-controlled switching between transducer channels having different characteristics
- Individual zero, span, scale factor, decimal point and other programmed controls for each channel
- Readouts appear on 8000SW indicator in engineering units properly scaled for each channel

Models 4000 and 4500 are programmable switching and range scaling units which permit a number of different transducer channels... having different transducer types, capacities, calibrations... to be read out by a single Model 8000SW indicator. Readouts appear on the Model 8000SW display in engineering units properly scaled for the transducer channel selected.

With this instrumentation, a common transducer indicator can be used to display the weights of different tanks having different sizes and capacities... of pressures sensed by multiple pressure transducers having different full-scale ranges. Or, the outputs of weight, pressure and other transducers can be displayed by the single Model 8000SW in systems where multiple types of transducers are intermixed.

The combination of programmable switching unit and one Model 8000SW indicator is ideal for small process control systems and test setups. The accuracy, resolution and other performance features of the Model 8000SW are available to all channels... yet, the total cost of instrumentation is low. Measurement accuracy for all channels is better than ±0.1% and repeatability is better than ±0.05%. Performance is 4 to 5 times greater than possible with comparable analog indicators.

The programmable transducer switching units consist of a compact mainframe assembly and multiple Model 440 programmer plug-in modules... one programmer plug-in for each transducer channel to be serviced. Each programmer plug-in has adjustments and internal hard-wired program patching facilities for its channel. The programmers can be individually set for:

- Transducer bridge zero balance
- Transducer span
- Full-scale engineering unit ranges greater than the basic ±10,000 range... using multipliers of 2 through 9 to obtain ranges from ±20,000 to ±90,000
- Positioning of decimal points on the engineering unit readout
- Modification of readout system linearity characteristics to compensate for transducer nonlinearities ...provide exact matching between readout and transducer on a channel-by-channel basis
- Cancellation of tare weights
- Generation of a BCD output code uniquely identifying the channel whenever that channel is activated for readout

Channels can be operator-selected by pushbuttons on the programmer plug-ins. Or, channels can be electronically-selected from remote locations.

MODEL 4000

The Model 4000 mainframe has provisions for up to five Model 440 programmer plug-ins. Operating power for one model 4000 with a full complement of plug-ins is supplied by the Model 8000SW indicator.

The Model 4000 mainframes are designed to permit interconnection of multiple units. When more than two Model 4000's are used in a system operating power is supplied by a Model 431 power supply module and not by the Model 8000SW indicator.

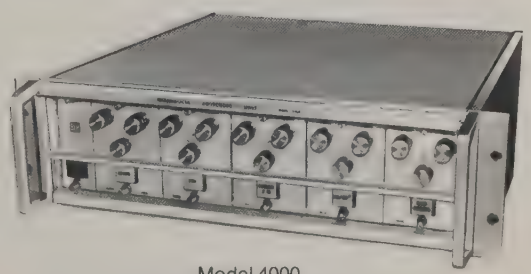
MODEL 4500

The Model 4500 mainframe has provisions for only two Model 440 programmer plug-ins and is intended for use in small system applications. Operating power for the Model 4500 and programmer plug-ins is supplied by the Model 8000SW indicator.

For complete specifications on the Model 4000 and 4500 programmable switching units, obtain BLH bulletin 619.

SPECIFICATIONS

Input Signal Level	minimum of ±1.0 mV/V for full-scale readout on Model 8000SW (1 microvolt per count); maximum of ±3.0 mV/V for full-scale readout on Model 8000SW
Model 8000SW Digital Readout	0 to ±10,000 full scale without multiplier option; overranging to ±20,000 (see page 29)
Accuracy	±0.1% of Model 8000SW full-scale
Transducer Excitation Supplied	10.0 Vdc @ 350 mA regulated, with remote sensing (5.0 Vdc and 15.0 Vdc available)



Model 4000

Transducer Signal Conditioners Models 7000, 7100, 7200

- Precision signal conditioners with accuracy of ±0.01%
- For continuous process control and transducer measurement applications
- Range of add-on options and accessories available
- All plug-in circuit board construction

Instruments in the Model 7000 series are advanced signal conditioners for use with strain gage transducers in laboratory and industrial applications. The signal conditioners scale strain gage transducer signals into proper ranges for direct readout in engineering units. They provide an amplified analog output voltage proportional to the scaled input signal with an accuracy of ±0.01%...and resolution of better than ±0.01% when used with Model 905/828 (see page 33).

When equipped with setpoints, these instruments become extremely accurate controllers for use in modern processing systems. And, their analog outputs can be supplied to a BLH Model 905 digital indicator for direct readout of the measured parameter on a 5-digit display in engineering units. Multiple signal conditioners can be read out using a single Model 905 indicator if a switching unit such as the BLH Model 828 is used in the system. In such multichannel systems, the signal conditioners with setpoints continue to monitor and control process operations even when their outputs are not being read out by the Model 905/828 equipment.

All 7000 models have electronic zeroing circuitry to automatically, continuously cancel instrument zero drift. All models supply excitation sufficient to drive up to eight 350-ohm or four 120-ohm full bridge transducers.

All models may be equipped with a wide range of options similar to the options available for the Model 8000 indicator. These include:

Internal Setpoints...for Model 7000 units only... adjustable from 0 to 100% of full scale for high and low limits.

Current Output...converts analog output voltage to analog output current for use by current-controlled process equipment and indicators.

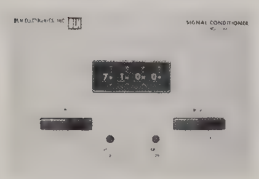
Bridge Linearization...modifies the Model 7000 linearity to correct for transducer non-linearity... achieves total system accuracy of 0.05% even with transducer nonlinearity up to ±0.25%.

Electronic Lowpass Filter...provides additional input integration to damp out unwanted fluctuations from pulsating and fluctuating signal sources.

The 7000 series signal conditioners can also be used with the Model 980/981 precision setpoint modules having main and dribble fill controls...and compensation for in-flight materials (see page 34).

Model 7000

Model 7100



Model 7200

MODEL 7000

The Model 7000 is a basic unit. It may be equipped with the two internally adjustable setpoints described under options.

MODEL 7100

The Model 7100 has one internally adjustable setpoint and one front panel thumbwheel setpoint for operator adjustment.

MODEL 7200

The Model 7200 has two front panel thumbwheel setpoints for operator adjustment.

SPECIFICATIONS

Input Signal Level	minimum ±1 mV/V for full-scale voltage (5 Vdc); maximum ±3 mV/V for full-scale
Analog Output Voltage	0 to ±5 Vdc @ 2 mA; overrange to ±8.5 Vdc
Accuracy	±0.02%
Resolution	better than ±0.01% when used with 905/828
Temp Effect on Zero	±0.001% of full scale/°F or 0.25 uV/°F, whichever is greater
Temp Effect on Span	±0.002% of reading/°F
Transducer Excitation Supplied	10.0 Vdc @ 350 mA, regulated, remote sensing (5.0 Vdc and 15.0 Vdc available)

Digital Indicator...Model 905

- High resolution 5-digit indicator for use with precision signal conditioners
- Displays measured parameters with an accuracy of ±0.01% and resolution of 1 part in 10,000
- Display ranges available up to full-scale of ±999,960

The Model 905 is a high resolution digital indicator for readout of parameters being monitored by signal conditioners such as BLH Models 450 and 7000. When used with these conditioners, the Model 905 displays measured parameters in engineering units with an accuracy of ±0.01%...and resolution of 1 part in 10,000.

When equipped with a Model 828 channel selector (see below), the Model 905 indicator can be used to read out measured parameters from up to 10 signal conditioners. In applications requiring only periodic readouts, the combination of 828/905 forms an optimum low-cost system. And, the signal conditioners continue to monitor their input parameters... control processing operations at all times...even when no readout is being made.

Display range of the basic Model 905 is 0 to ±10,000 full-scale (overranging to ±20,000). A digital multiplier option allows the basic ±10,000 full-scale range to be multiplied by integers 2 through 9 in order to obtain full-scale engineering unit display ranges of ±20,000 to ±90,000. Also, an optional dummy zero can be added in the least significant digit position for applications requiring full-scale engineering unit displays greater than ±100,000. The instrument retains its full 1:10,000 display resolution with either or both of the display range expansion options.

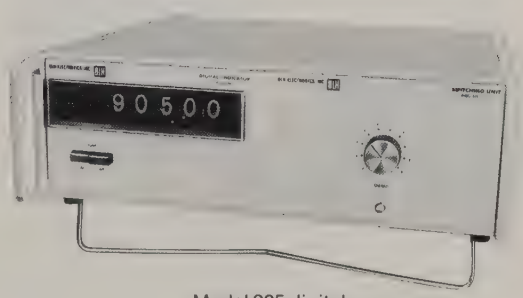
Other options available for the Model 905 include:

Least Significant Digit Desensitization...forces the readout to change in least significant digit steps of 2 or 5 rather than 1. Avoids unnecessary, annoying display changes in applications where inputs fluctuate or pulsate about an average value.

BCD Data Output...makes measured parameter values available in parallel BCD form compatible with TTL logic. A data ready output is also furnished for receiving devices requiring such a control for their data transfer operations.

SPECIFICATIONS

Input Signal Level	0 to ±5 Vdc; overranging to ±8.5 Vdc
Digital Readout	0 to ±10,000 without multiplier option; overranges to ±20,000
Accuracy	±0.01% of full-scale ±1 count (includes linearity effects)
Resolution	1:10,000



Model 905 digital indicator shown with Model 828 switching unit

Channel Selector...Model 828

The Model 828 is a 10-channel switching unit which allows a single Model 905 digital indicator to display data from multiple signal conditioners in a system installation. Since the Model 828 switches only conditioned signals it contains no transducer zero balancing, span adjustment or scaling functions. Each channel selected by the Model 828 is identified by a BCD output on the instrument back panel.

For further information on the Model 828, obtain BLH bulletin 8000/905.

Setpoint Modules...Models 980, 981

- Advanced analog process control setpoints... accurate to ±0.1%
- Master and slave modules for two-step, interlocked control of main and dribble fill operations
- Both models have automatic compensation for in-flight materials

Models 980 and 981 are precision setpoints for control of batching, filling, emptying and similar processing operations. Desired setpoints are selected on the module front panels. The modules continuously monitor the analog output voltage from BLH Model 450, 7000 or 8000 signal conditioning instruments and initiate a contact closure exactly when a measured parameter reaches the set control point. Accuracy is greater than ±0.1% of full-scale.

The Model 981 is a master setpoint for cutoff of material flow, signaling of high or low limits and similar applications. The control point is dialed by an operator on a front panel thumbwheel switch ranging from 0000 to 9999.

The Model 980 is an auxiliary setpoint which can be slaved to the Model 981 for applications requiring two-step control...sequential operation of main and dribble fill valves, for example. In these applications, the Model 980 initiates a contact closure at a point ahead of the Model 981 contact closure. The amount by which the 980 will lead the 981 is set by a ten-turn control on the 980 front panel...and can be from 0% to 20%.

The master/slave design maintains the same absolute value difference between the two modules no matter what new control point values are dialed into the Model 981 thumbwheel switches. Thus, an operator may change the sizes of batches at will, but the relationship between main and dribble fill operations will remain unchanged...without need for operator readjustment.

Both setpoint modules contain in-flight compensation circuits which allow for material still in pipes, chutes, etc., after valves have closed. The operator need not set the front panel control point for cutoff at a value below that actually required. The internal compensation circuits perform this function automatically after their initial adjustment.

Model 980 Model 981

Both setpoint modules are also equipped with hysteresis control circuits which insure that contact closure is made and held the first time a setpoint is reached. This feature eliminates relay chatter which would otherwise result from fluctuating, sloshing loads.

The Model 980 and 981 setpoints are available for use with either increasing or decreasing signals... for control points set as high or low limits. For complete specifications, obtain BLH bulletin 622

SPECIFICATIONS

Accuracy	0.1% of full-scale
Repeatability	0.05% of full-scale
Resolution	maximum of 0.01% for full-scale setting of 9999
Hysteresis	±2% of full-scale
Temp Effect on Zero	±0.005% of full-scale/°F
Temp Effect on Span	±0.005% of full-scale/°F

Digital Tare Cancellation and Setpoint Modules Models 995, 997

- All-digital setpoint design...accuracy of ±0.01%
- Full 5-digit tare cancellation...also with accuracy of ±0.01%
- Combine with Model 8000ST indicator for fast, accurate weigh-in/weigh-out systems

The Model 995 is a completely digital tare cancellation unit for use with Model 8000ST indicator (page 29) in systems requiring accurate net weight readout. An operator dials known tare weight of container on the Model 995 front panel thumbwheels, and the Model 8000ST displays net weight with resolution of 1 part in 10,000. (Gross weight can also be displayed by placing the tare cancellation thumbwheels at 00000.)

The Model 997 is also a digital tare cancellation unit, but in addition has two digital comparison type setpoints. It is designed for extremely accurate batching of two ingredients or feeding one ingredient at fast and slow rates. Tare weight of container is set on a 5-digit tare cancellation thumbwheel. Desired net weights are set on two 5-digit setpoint thumbwheels. Accuracy of the setpoint operation equals the accuracy of the tare cancellation...±0.01%.

The 995 and 997 modules are designed for use only with the Model 8000ST indicator. Performance specifications for the modules are essentially the same as those for the indicator.

Strain Gage Transmitter...Model 882

- Converts mV/V strain gage transducer outputs to current signals suitable for standard process control instrumentation
- Input range from 0.8 to 3.0 mV/V full-scale . . . output ranges of 4 to 20 mA and 10 to 50 mA
- Extremely stable, repeatable, linear conversion and gain characteristics
- Built-in transducer excitation power supply

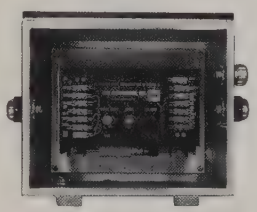
The Model 882 converts mV/V strain gage transducer outputs to standard current control signals widely used in the process control industry . . . 4 to 20 mA and 10 to 50 mA. All necessary signal conditioning, transducer bridge excitation and control functions are provided for direct interface between strain gage transducers and standard process control instrumentation.

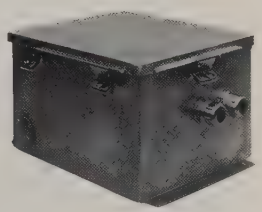
The Model 882 output capabilities are suitable for directly driving all of the calibrated process instrumentation presently offered by the major manufacturers. And, system repeatabilities (including transducers) better than 0.01% of full-scale can generally be attained using the Model 882 in such applications.

All components are contained within a NEMA 4 enclosure. (An optional explosion-proof housing is also available.) For complete information, obtain BLH bulletin 613.

SPECIFICATIONS

Transducer Compatibility	all types having 120 or 350 ohm bridges; 0.8 to 3.0 mV/V rated outputs
Current Outputs	4 to 20 mA, 0 to 1500 ohms 10 to 50 mA, 0 to 600 ohms
Linearity	±0.20%
Repeatability	±0.05%
Sensitivity	±0.05%
Gain Stability	less than ±0.10% change over 8 hours
Zero Stability	less than ±0.10% change or ±0.002 mV/V in 8 hours, whichever is greater
Temp Effect on Span	±0.002%/°F
Temp Effect on Zero	0.25 μV/°F (electronic zero)
Transducer Excitation Supplied	10.0 Vdc, regulated
Compensated Temp Range	−20°F to +140°F





Model 882

Strip Chart Recorder...Model 326

- Automatic null-balance system maintains accuracy over full chart width
- Select from wide range of chart speeds and optional features

The Model 326 is an automatic servo null-balance strip chart recorder which provides continuous hard copy records of measured parameters. Single and dual pen models are available; both pens record over the full area of the 11-inch wide strip chart. If more than two channels are required, BLH switching units may be used. Or, the basic recorder can be obtained with an optional 24-channel hammer-type printing mechanism.

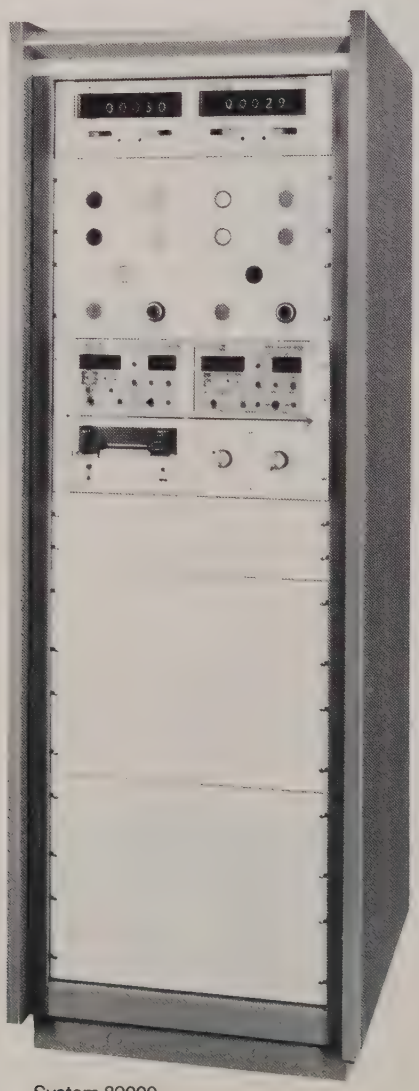
Mechanical design is extremely rugged, built for long maintenance-free life in the industrial environment.

Chart speeds from 1 inch/hour to 30 inches/minute and faster may be obtained, and a large number of options are available for use with the basic recorder. Send for BLH bulletin 610.

Model 326

Digital Batch Control System...System 89000

- Precision automatic system for filling, batching, mixing, dispensing
- Delivers ingredients within ±0.05% of desired, programmed amounts
- Desired ingredient quantities entered by operator, by computer, by punched tape or card reader
- Handles up to 8 ingredients via plug-in control modules
- Provides two-step, interlocked control for main and dribble fill operations
- Compensates automatically for ingredients in-flight after shutoff commands
- Prints out exact weights of ingredients delivered ...a permanent record of exact quantities in the final batch
- Non-accumulative batch weights



System 89000

The BLH 89000 is a fully automatic system for control of filling, batching, mixing and emptying operations. The system performs all processing and control functions digitally using high-speed, solid state circuits. Batch weight and programmed ingredient weights are controlled with speed and accuracy impossible to obtain from any analog circuit or setpoint design.

Because of these factors, the system can precisely control operations involving very high material flow rates through large pipelines and valves.

Weights of ingredients needed for a batch are read into the system by an operator...by a remote computer...by a punched card or tape reader. When given a start command, the system proceeds to batch the ingredients automatically. It opens and closes main and dribble fill valves...operates all other remotely actuated devices needed for the complete batching operation. It provides time delays between ingredients as needed for mixing and blending.

Each ingredient is delivered to the batch in a programmed sequence, in the exact amount specified by the programmed instructions. Deliveries are controlled with an accuracy of ±0.05%. No operator intervention is required at any time during a normal batching sequence.

The programmed sequence of ingredient deliveries may be changed as desired. Or, programming can specify that certain ingredients be completely omitted from a particular batch. The system can be set to await confirmation of an ingredient shutoff valve closure before proceeding with batching of additional ingredients. Automatic zeroing is performed between each ingredient addition...there is no cumulative measurement error buildup.

During all ingredient deliveries the system automatically compensates for valve closure time...for in-flight material remaining in pipelines and chutes after delivery shutoff is commanded. The in-flight compensation is initially entered in the system for each ingredient. In all subsequent operations, the system issues shutoff commands which lead the actual weights desired by amounts equal to the offsets. Thus, when in-flight materials reach the batching container, the exactly desired ingredient amounts have been delivered.

The built-in digital printer provides a hard copy of exact ingredient quantities delivered to the batch. Thus, a permanent record of actual finished batch content is available for quality control use and for other purposes.

Two printers are available. One is a 10-column model which prints ingredient ID and weight data. The second model is a 21-column unit which adds day, hour and minute information to each printed ingredient entry on the tape.

The BLH Model 8000 digital transducer indicator is used in the system to perform signal conditioning and analog-to-digital conversion. This instrument has accuracy of ±0.01% and resolution of 1:10,000 as described on page 28. The total weight of ingredients being added to a batch is continuously displayed on the Model 8000 5-digit readout in engineering units (pounds, gallons, tons, etc.) The instrument has automatic zeroing circuitry which cancels zero drift automatically. As an option, the BLH Model 8900 batch indicator may be added to the basic system to provide a digital display of each batch weight. When the 8900 indicator is included, ingredient weights are displayed by the 8900 indicator and total weight is displayed on the 8000.

The central element of the system is the batch controller which contains plug-in digital batcher modules... BLH Models 990 and 991. The Model 990 plug-in is a master unit which can handle all operations needed for one ingredient. The Model 991 plug-ins are slave units which have provision for control of additional ingredients. Up to 7 of the 991 modules may be used. Thus, the system is easily configured for operation with up to 8 different ingredients.

The system offers BCD data outputs indicating weight values of ingredients being delivered to the batch. The outputs are compatible with TTL logic and are suitable for use by external displays, printers, data acquisition systems and other digital instrumentation.

An optional overage sensor/control unit is available. With this option a system operator can dial in the limit of acceptable overage. If this limit is exceeded for any reason, the system will enter a batch interrupt mode and remain so until a restart is commanded by the operator after he has evaluated the situation. An overage alarm light and contact closure operate when overage is exceeded.

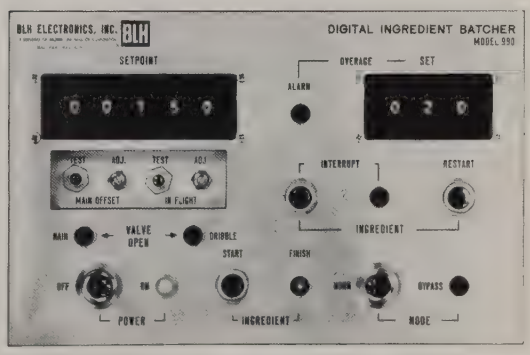
The system 89000 can be supplied in several different physical configurations:

- As a graphic panel unit showing piping, valves, containers on the panel with suitable lamps and indicators to display the status of the progressing operations
- As a circular desk-type operator console
- As a single vertical rack-type cabinet with all controls available to an operator
- As a vertical rack-type cabinet with a locked front door... only status lamps, printer and start/stop controls are available to an operator.

For further information on the Model 89000 digital batching system, obtain BLH bulletin 618.

SPECIFICATIONS

Accuracy:	Batch accurate to ±1 count referred to the primary weighing system consisting of the Model 8000 and load cells. Primary system can be as accurate as 0.1% of full scale or with dead weight loading as high as 0.05% of reading.
Resolution:	Better than ±0.01%
Number of Ingredients:	Up to 8
Operating Temperature:	+32°F to +130°F (0-55C)
Power Requirements:	100/115/200/230 V ±10%, 50-60 Hz
Contact Closure Rating:	(3) 1 Amp –115 Vac (1 amp –28 Vdc) SPDT, non-inductive relays per ingredient batcher, including optional overage alarm
Output:	Standard TTL 5 BCD 1-2-4-8 digits
Display:	Each indicator – five 0.5" H miniature gas discharge tubes
Physical:	Custom designed



Model 990

System Accessories

BLH offers a broad line of the accessory items needed to construct complete systems using the company's transducers and measurement instrumentation. The accessories include:

- Mounting hardware for load cell weighing systems used with tanks, bins, hoppers, silos and other fixed containers
- Lift and weigh devices for load cell crane scales and similar applications
- Instrument enclosures for hazardous and severe environments
- Standard and explosion-proof junction boxes for cable connections and for summing multiple transducer outputs

WEIGHING SYSTEM MECHANICAL MOUNTINGS

These items are used with weighing systems for a wide variety of fixed containers. They provide proper coupling of the container weight to supporting load cells. They assure strength and environmental survivability of the entire structure...container plus load cells. They restrain the container with proper elasticity, expansion allowance and other conditions needed to insure fully accurate vertical load (weight) measurement.

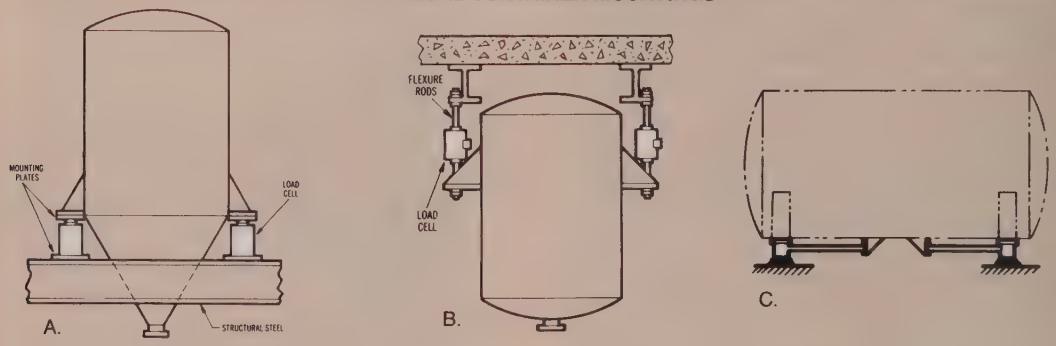
Some typical fixed container weighing installations are shown below. For detailed mechanical design data on these and many other installations, obtain BLH Weighing System Handbook TM-MECH DESIGN-2. For complete specifications of the available mounting accessories, obtain BLH bulletin 003.

LIFT AND WEIGH DEVICES

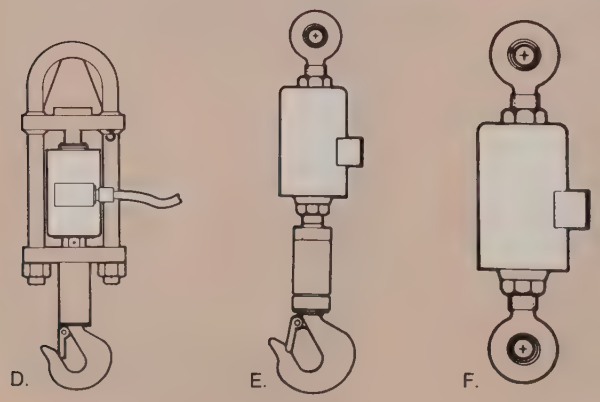
These devices are used with tension calibrated load cells for applications in which the weight to be measured is lifted by a crane or other mechanism. All BLH lift and weigh devices can be fitted with suitable overload yoke to meet the requirements of the National Crane Safety Council.

Typical lift and weigh devices are shown below. Many other models and fittings are available. For complete specifications, obtain BLH bulletin 003.

TYPICAL CONTAINER MOUNTINGS



TYPICAL LIFT AND WEIGH DEVICES



A. Vertical tank (silo) supported on compression load cells and mounting plate accessories.

B. Indoor vertical tank suspended by tension load cells with flexure rod accessories.

C. Horizontal tank supported on compression load cells and expansion accessories.

D. Complete crane scale including overload yoke.

E. Typical lift and weigh unit with spherical rod end and swivel hook.

F. Typical lift and weigh unit with 2 spherical rod ends.

MODEL 78 INSTRUMENT ENCLOSURES

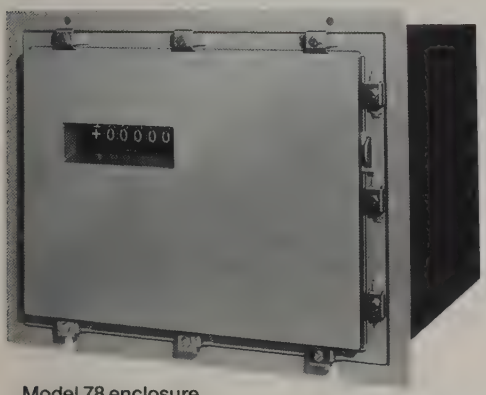
These units are designed for use where equipment must be operated in particularly severe or hazardous environments. The enclosures will house from one to three instruments... can be panel-mounted or used on a pedestal base.

NEMA type 4 construction is used in the Model 78 enclosure. Windows are provided in the enclosure door so that instrument readouts can be easily viewed from outside.

Options are available for applying a slight positive air pressure to the interior... for shutting off instrument power when an interlock senses that the front door of the enclosure is being opened... for heating the enclosure interior when needed in ambients below +32°F.

Enclosures can be supplied to National Fire Protection Association specifications.

For complete information on the Model 78 enclosures, obtain BLH bulletin 614.

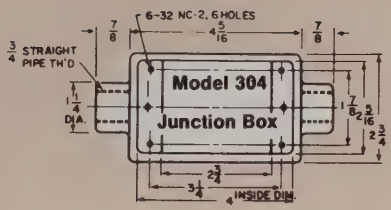


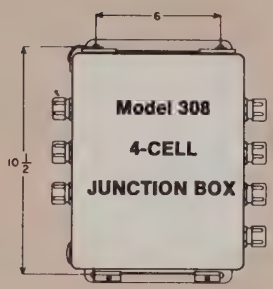
Model 78 enclosure

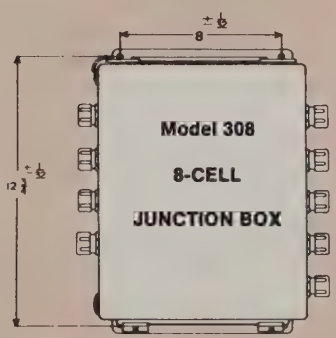
JUNCTION BOXES AND INSTRUMENTATION CABLE

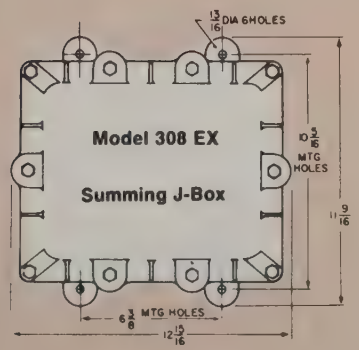
These items are needed when: (a) required cable run lengths exceed the lengths of cables supplied with transducers and/or (b) the outputs of several transducers must be summed into a single channel.

For such applications, BLH manufactures rugged junction boxes in both standard and explosion-proof models. And, special BLH transducer instrumentation cables are highly recommended to insure that the full accuracy and dynamic performance of the transducers are retained in the installed system. Special shielding and other characteristics of BLH instrumentation cables allow measurement of smaller signals... offer greater accuracy at all signal levels.









Complete Process Control Systems

BLH is a uniquely qualified source of complete process control systems as well as the basic system components. The company's experience in this field is massive... includes custom system designs for virtually all industries in which automatic process controls are used. The BLH systems engineering organization has in-depth experience with process control technology for ingredient batching, blending, dispensing and materials handling and weighing.

Three key factors which result in greater profit for users of BLH process control systems are: 1) reduced labor costs through automation; 2) improved product quality with fewer rejects through greater accuracy of mixing and blending; and 3) closer inventory control insuring steady production with minimum material in inventory.

Typical industries served by BLH are:

- Chemical
- Primary metals
- Food processing
- Beverage
- Petroleum
- Aerospace
- Automotive
- Construction

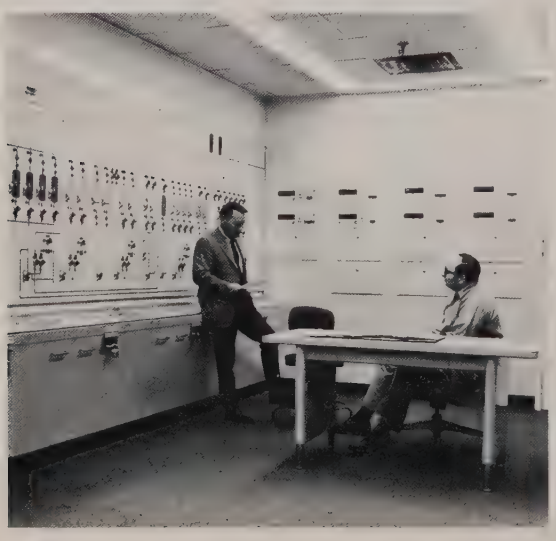
For these operations and many others, BLH supplies automated systems having accuracies and performance in compliance with NBS Handbook H44 requirements for buy and sell weighing. And, BLH supplies intrinsically safe systems certified for use in hazardous areas... in explosive and flammable environments of gases, volatile liquids, and dust particles. Virtually all BLH transducers and interconnection system components are approved by both FACTORY MUTUAL and CANADIAN STANDARDS ASSOCIATION as intrinsically safe in Class 1, Division 1, Group C and D hazardous applications when installed with BLH certified electrical barrier according to applicable BLH drawings.

For custom process control systems, BLH will furnish:

- Engineering services for analysis of system requirements; specification of mountings used with tanks, bins, hoppers and other containers; and all other planning assistance required
- Physical measurement transducers best suited to the system... either standard models or custom units adapted to special needs
- A total instrumentation package... including operator and/or computer controlled functions as required
- Engineering assistance during system installation, calibration and start-up operations
- Continued field service support... spare parts... documentation... personnel training programs... operation and maintenance manuals
- Additional engineering if needed at any future time for expansion of the system or implementation of altered processing requirements

Such a complete set of start-to-finish services... with the detailed component and system experience to back them up... is available only from BLH Electronics.

BLH electronic weighing and control system for large distillery... installation includes 28 tanks with total capacity over 3.7 million pounds... system accuracy of ±0.1% certified by Weights and Measures Division of Canadian Government.



BLH control system for major chemicals manufacturer... installation provides precision control for the production processes.

Universal Transducer Indicator...Model 8100A

- A single, universal instrument for differing transducer types...any span from 0.75 to 5.0 mV/V... any capacity to 99,999 full-scale
- Offers full performance features of all 8000 series indicators...accuracy of ±0.01% and resolution of 1 part in 10,000
- Specifically designed for versatility in multiple uses...laboratory work, manufacturing, calibration and many others

The Model 8100A is designed for maximum versatility . . . for easy, accurate readout of different transducer types having different calibrations, capacities and bridge resistances. The instrument is a self-contained signal conditioner/indicator/excitation supply. It has many uses in laboratory testing and calibration applications...for testing individual transducers during design and manufacturing...for checking transducers in systems.

Front panel controls allow selection of any transducer span range from 0.75 mV/V to 5.0 mV/V. Front panel controls also select display scale factor multiplier to program readouts in engineering units accurate to ±0.01% with resolution of 1:10,000.

Mode Selection Switches are included to provide digital display of (1) the input signal or, (2) the calibration signal, or, (3) the MV/V span for the transducer in use. No interpolation of settings needed.

The basic full-scale range is 0 to ±10,000 with the MULTIPLIER control at 1. For greater ranges, the MULTIPLIER control can be set at any integer from 2 through 9. Thus, full-scale engineering unit ranges from ±20,000 through ±90,000 can be easily obtained.

Because of these features, the Model 8100A is a truly universal indicator for all types of transducers. For example: if used with a pressure transducer having a 30,000 psi capacity and 1.5 mV/V output, the Model 8100A SPAN control is set at 1.5 mV/V and the MULTIPLIER control at 3. Under these conditions, the Model 8100A will display pressure from 0 to ±30,000 pounds with least significant digit scaling in units of 3. The instrument's inherent 1:10,000 resolution is retained at all settings of the SPAN and MULTIPLIER controls.

Other features of the Model 8100A are the same as those of all BLH 8000 series indicators (see page 28 & 29).

Automatic electronic zeroing circuits continuously cancel any instrument zero drift. Bridge excitation is precisely regulated and is equipped for remote sensing.

Options are available for: (a) outputting measured parameters in BCD for use by printers and other digital instrumentation, (b) modifying the Model 8100A linearity characteristics to compensate for non-linearity in attached transducers. Total system accuracies of ±0.05% can be obtained with the linearity adjustment option.

For complete specifications, obtain BLH bulletin 628-1.

Model 8100A

SPECIFICATIONS

Input Signal Level	switch-selected span ranges from ±0.75 mV/V to ±5.0 mV/V for full-scale readout
Digital Readout	0 to ±10,000 with MULTIPLIER control at 1 (overranging to ±20,000); MULTIPLIER control adds ranges in integer steps from 2 through 9 for maximum full-scale range of ±90,000 (to ±99,000 with overranging)
Analog Output	0 to ±5 Vdc @ 2 mA, accuracy of ±0.25%
Resolution	1 part in 10,000 at all settings of SPAN and MULTIPLIER controls
Accuracy	±0.01% of reading ±1 count
Linearity:	±0.01% of reading ±1 count
Temp Effect on Zero	±0.001% of full-scale/°F or ±0.25 uV/°F, whichever is greater
Temp Effect on Span	±0.005% of selected span range/°F
Bridge Excitation Supplied	10.0 Vdc @ 350 mA regulated, with remote sensing (5.0 Vdc and 15.0 Vdc available)

Force Calibration Systems

- All-electronic secondary standards for calibration of force measurement equipment
- Accurate to ±0.05%... a maximum error of only ±50 pounds when measuring a 100,000 pound force
- Lightweight, rugged construction... fully portable ...easily transported and set up
- Direct digital readout in force units... no data interpretation or interpolation required

BLH force calibration systems are secondary standards used to calibrate other force measurement transducers, systems and test equipment. Specially tested and documented BLH load cells are the basic force sensing units. A BLH Model 8200A calibration indicator performs the signal conditioning and readout functions. The complete system... load cell(s) and indicator... is calibrated with extreme precision on the NBS-certified dead weight primary standard at BLH (see page 21).

The calibrated secondary standard system provides guaranteed accuracy of ±0.05% or greater. Thus, a 24,000 pound force can be measured with total error less than ±12 pounds... or a 240,000 pound force can be measured with total error less than ±120 pounds.

Compared with conventional mechanical calibration equipment, the all-electronic BLH secondary standard systems offer:

- Simpler setup and operation... force is displayed in engineering units on a digital readout... no interpretation, look-up table or interpolation is required.
- Easier handling... all system components are rugged and lightweight... a complete system for forces up to 24,000 pounds weighs less than 50 pounds
- Lower sensitivity to temperature variations
- Easier maintenance and calibration recertification

The Model 8200A calibration indicator has front panel adjustable linearity characteristics which can be set to automatically compensate for load cell nonlinearities up to ±0.3%. Load cells having spans from 2.0 mV/V to 3.6 mV/V can be used with the Model 8200A.

The basic digital readout range is 0 to ±10,000 (to ±20,000 overranging). A front panel digital multiplier control extends this range by integers of 2 through 9 to obtain full-scale displays up to ±90,000 as with the Model 8100A indicator (page 41). An optional dummy zero can be used in the least significant digit position to obtain display ranges above ±100,000. Resolution is 1 part in 10,000 for any range selected.

The 8200A provides digital display of force, calibration, and linearity adjustment signals.

The Model 8200A also contains all the other features of standard BLH 8000 series indicators (pages 28&29). These include: (a) automatic instrument zero drift cancellation, (b) optional BCD data output, (c) precision bridge excitation power supply.

The special calibration-quality load cells used with the Model 8200A indicator are available for universal tension and compression service or for compression service only. The universal cells may be ordered with full-scale capacities from 60 to 240,000 pounds. The compression only cells may be ordered with full-scale capacities from 24,000 to 240,000 pounds.

Both load cell types are shipped with calibration/linearity charts showing their dead weight test results determined by calibration loading procedures performed over their entire load range.

For complete information on force calibration systems, obtain BLH bulletin 620.

Model 8200A shown with force calibration load cell C2P1

Precision Calibrator ... Models 624, 625

- For calibration/testing of instruments used with metallic strain gages, strain gage transducers or any millivolt source
- Simulates outputs from 120 and 350-ohm strain gage bridges ... in precision mV/V steps accurate to ±0.05%

The Model 625 is a portable resistance network which simulates electrical output signals from full-bridge metallic strain gage transducers. The instrument produces 55 precision mV/V outputs in five ranges of 11 settings each.

The Model 625 is designed for checking calibration, linearity and sensitivity of measurement instruments including indicators, signal conditioners, recorders ... even complete force measurement and process control systems. The Calibrator derives its output voltages from a normal bridge excitation source or from any source of known voltage, either ac or dc.

The Model 624 is a vernier attachment which provides continuously variable output between the Model 625 output steps. The 624/625 combination can be used to check and adjust setpoint controllers, tare cancellation units, peak and hold circuits, and similar instrumentation functions.

For complete specifications on Models 624 and 625, obtain BLH bulletin 612.

SPECIFICATIONS

Output Accuracy	each point accurate to ±0.05% of reading or ±0.02% of range or ±0.003 mV/V or ±2 uV, whichever is greater
Zero Stability	better than ±2 uV
Calibration Stability	better than ±0.02%

Model 625

Transducer Indicator ... Model 352A

- A low-cost, portable indicator for testing and troubleshooting
- All solid state ... requires no warmup

The Model 352A is a manually null balanced, percent-reading indicator for use in transducer testing and troubleshooting. It is portable, battery powered ... for use in the field. It can be used to check outputs of either 120- or 350-ohm transducers ... to confirm that transducers are operating correctly before sealing their cable connections in a system installation. And, the Model 352A may be used to determine whether multiple transducers in a system are equally loaded.

For complete specifications, obtain BLH bulletin 352A.

Model 352A

Installation and Service Test Set...Model 3562

- Low-cost standard for calibration and servicing of strain gage transducer systems.
- Portable, rugged construction for field use.

The Model 3562 provides all necessary equipment in one package to install or service installations using strain gage transducers, instruments, and systems. The instruments are housed in a rugged, portable case, battery operated, that can be used for almost any installation or for servicing. Components include the Model 624/625 Precision Calibrator, the Model 352A Transducer Indicator (both described above), and a Multimeter for checking bridge resistance and electrical leakage.

For complete details, obtain BLH Bulletin 611.

Model 3562

On-Board Aircraft Weighing System...OBAWS

- Can be installed on most jet transport aircraft... furnishes accurate weight and center-of-gravity readouts continuously while on the ground
- Measures only true weight...ignores all side forces from winds, turns, irregular apron surfaces
- Options available for fully automatic detection/identification of blown tires...soft struts... excessive landing shocks...improper aircraft center-of-gravity alarm
- The perfect system for supervision of loading and stowage...exact weight and balance always available at a glance

OBAWS is an integral, on-board electronic weighing system which furnishes continuous weight and center-of-gravity readouts for its carrying aircraft while on the ground.

Special BLH transducers, permanently installed in landing gear, sense weight loads on the wheels. A small, rugged computer unit in the aircraft automatically totals the wheel loads and computes aircraft center-of-gravity. The computed data is displayed by a readout unit available to the flight engineer and other operational personnel.

The system provides operational personnel with an accurate running check on aircraft weight and balance. It speeds cargo stowage...enables predictable trim for safe takeoff and stable flight. It eliminates tedious, inexact calculations previously required to determine gross weight and longitudinal cg. Accuracy is better than ±1%.

The BLH transducers respond only to vertical force (weight). They ignore all side forces caused by winds, tight turns, racking, worn tires, irregular or sloping apron surfaces. They produce accurate load indications at all times when wheels are in contact with the ground...while parked and loading...taxiing... at landing and takeoff.

The transducers are easily installed on most aircraft ...commercial or military...with any landing gear design. Designs are immediately available for most large jets since the OBAWS system is incorporated in the design packages of most major airframe manufacturers. No special fittings are required for the landing gear axles. No periodic checks are required after installation. Pressurization is not required.

The OBAWS system can be equipped with a number of special options as needed for different applications.

These options include:

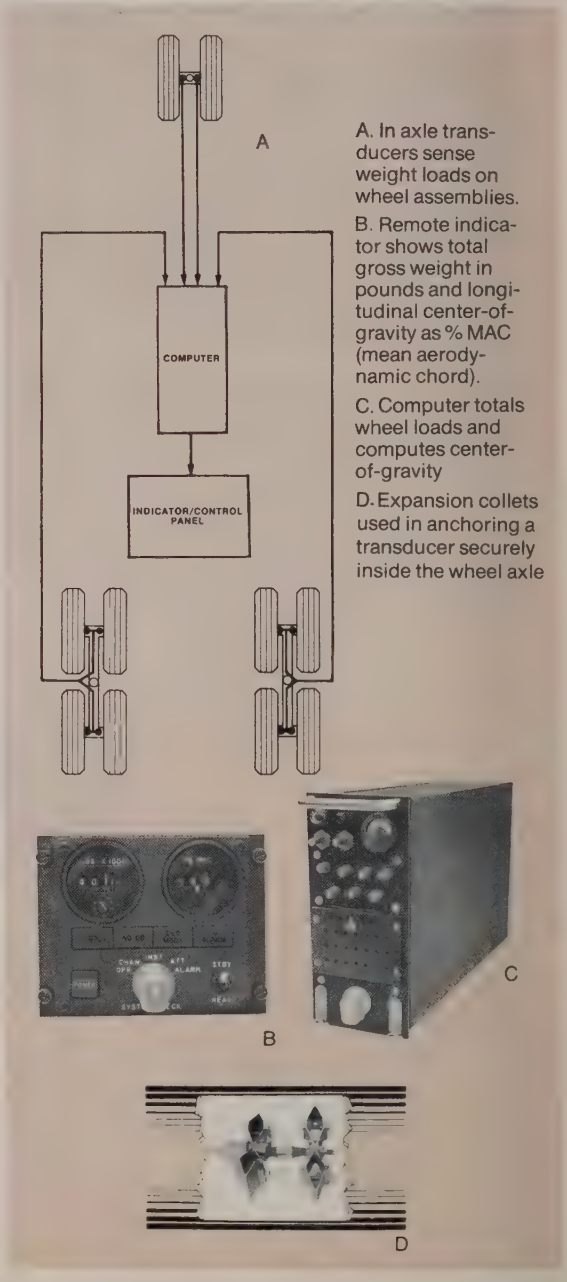
Hard Landing (Impact) Indicator...records impact loads on individual landing gear assemblies. Records any unusual stresses encountered. Also, operates a panel alarm if any landing gear receives a shock load beyond preset limits.

Blown Tire Indicator...operates a panel alarm if any tire is blown. Also, identifies the landing gear assembly on which the blown tire is located.

Soft Strut Indicator...operates a panel alarm if any landing gear strut goes soft, i.e., pressure falls such that strut is soft beyond preset limits. Also, identifies the landing gear assembly on which the soft strut is located.

Center-of-Gravity Alarm...operates a panel alarm any time the aircraft center-of-gravity location moves outside preset limits.

Lateral Center-of-Gravity Indicator...provides an additional readout showing aircraft lateral center-of-gravity.



A. In axle transducers sense weight loads on wheel assemblies.

B. Remote indicator shows total gross weight in pounds and longitudinal center-of-gravity as % MAC (mean aerodynamic chord).

C. Computer totals wheel loads and computes center-of-gravity

D. Expansion collets used in anchoring a transducer securely inside the wheel axle

Mobile Electronic Weighing System...MEWS

- A mobile, electronic, drive-on weighing system for aircraft and other vehicles
- Displays gross weight with accuracy better than ±0.15%...weighs a 200,000 pound aircraft with total error less than ±300 pounds.
- Computes and displays center-of-gravity with accuracy of ±1 inch

MEWS is a mobile, all-electronic system for weighing aircraft and other vehicles...easily, quickly, accurately, safely. Portable strain gage platform scales (with detachable drive-on ramps) sense weight loads on the vehicle wheels. A dolly-mounted instrument package automatically totals the wheel loads and computes center-of-gravity with respect to an operator-entered reference datum.

The total gross weight and center-of-gravity are displayed on easy-to-read digital indicators requiring no operator calculations or interpretations. Accuracy of the weight measurement is ±0.15%... can be increased to ±0.1% with matched instrument/platform scale calibration. The center-of-gravity readout is accurate to ±1 inch.

MEWS is a thoroughly proven system. It is in use around the world with commercial airlines and the U.S. Air Force. It will handle any aircraft presently in service...is daily weighing 747's and DC-10s at several major airline facilities.

The system is ideally suited for aircraft weight and balance measurements...

- At terminals during loading operations (when integral, on-board weighing systems like OBAWS, page 44, are not feasible for an aircraft fleet)
- At major maintenance facilities where calendar and after-overhaul/modification checks are performed as required by government regulations ...and where recalibration of integral, on-board weighing systems may also be performed
- At manufacturing facilities where measurements are required after final assembly
- At flight test facilities where effects of design and equipment complement changes must be measured and recorded.

The MEWS weighing platforms are only 5 inches high. They can be placed on any relatively level surface. The detachable ramps have a slope less than 5%...vehicles to be weighed are easily driven or towed up the ramps onto the weighing platforms. The complexity and hazards of conventional "jack-up" aircraft weighing methods are completely eliminated.

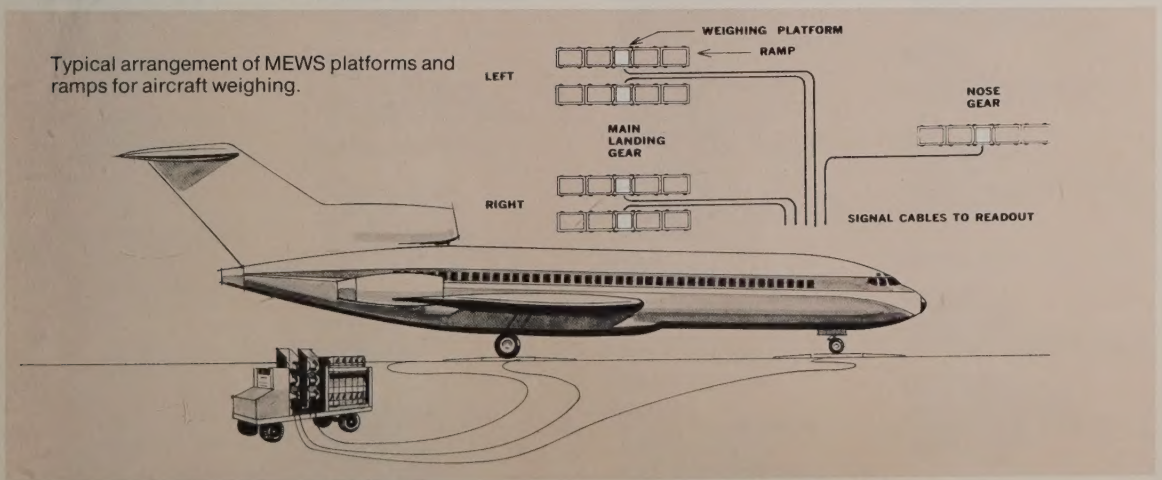
All components are weatherproof...can be used and stored in any weather condition. The system meets all U.S. military and commercial aviation industry specifications for protection against fungus, rain and vibration. It can be operated in temperatures from 0°F to +120°F; it can be stored at temperatures from −69°F to +160°F.

The instrumentation dolly has stowage for all weighing platforms, ramps and cables. Tiedowns allow transport of the fully loaded dolly. The system will operate from either 115 V, 40 to 400 Hz power or from standard 28 Vdc aircraft power.

OTHER APPLICATIONS

The MEWS system has also been used to weigh many vehicles other than aircraft. It has been used with heavy wheeled and tracked vehicles...trucks, tractors, trailers, armored carriers and others. In such applications the system is configured to display loaded vehicle lateral and longitudinal center-of-gravity data. Truck ramps and other equipment items for these applications are available from BLH.

The system has also been used with palletized/containerized cargos before loading onto carriers. For these applications, BLH supplies weighing roller conveyer sections which are inserted into established conveyer lines.



Typical arrangement of MEWS platforms and ramps for aircraft weighing.

Treadle Scale Weighing Systems

- Rugged, sealed weighing units for permanent installation in highways, truck loading/shipping yards... any vehicle weighing station
- All-electronic sensing and readout of gross weight ... individual axle weight loads... lateral weight distribution... vehicle direction of travel

BLH treadle scale weighing systems generate precision electrical signals proportional to vehicle axle weights up to 36,000 pounds. The weight loads on individual wheels are sensed by strain gage platform scales designed for flush mounting in roadway surfaces. The platform scales are hermetically sealed and contain no moving parts. They are unaffected by any weather conditions... operate with unimpaired accuracy in rain and freezing weather. Deflection under full load is extremely small.

A compact electronic instrumentation package supplies all power required by the scales and monitors their output signals. Depending on information desired, the instrumentation can include readouts for display of:

- Vehicle total gross weight
- Weight loads on individual axles
- Left and right lateral weight loads
- Vehicle center-of-gravity
- Vehicle direction of travel with respect to travel lane

Instrumentation can be provided for direct numerical readout of the measured data and/or for alarm operation when any of the measured quantities exceeds preset limits.

SALES AND SERVICE OFFICES

Effective April 1978

United States and Canada

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AK	10
AZ	3
AR	3
CA	11
CO	3
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DE	6,9
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KY	4
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OH	5
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SD	8
TN	4
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VA	4,9
WA	10
WV	5
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WY	3
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7. **Ossmann Instruments, Inc.**
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CANADA–See List Above

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